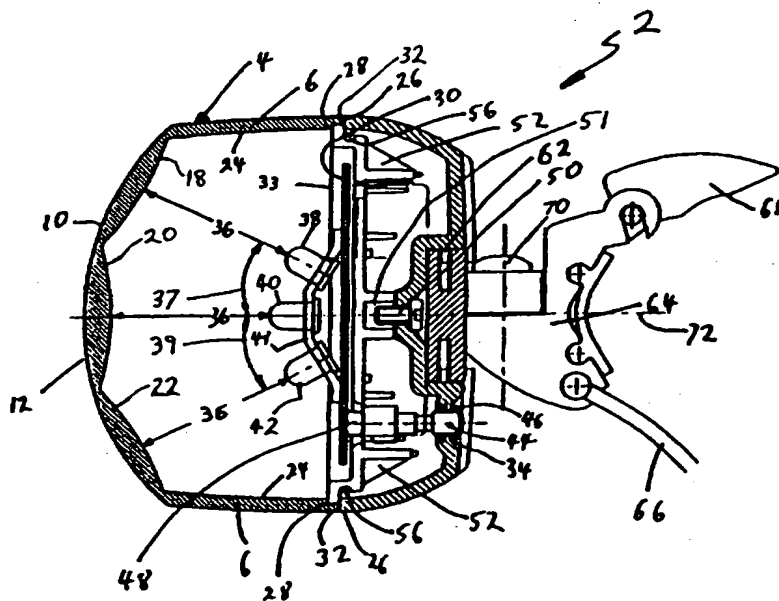




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>6</sup> : F21L 15/02, 7/00, 15/06, B62J 6/04, 6/02, 6/20		A1	(11) International Publication Number: <b>WO 98/06975</b>
			(43) International Publication Date: 19 February 1998 (19.02.98)
(21) International Application Number: PCT/AU97/00513		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GII, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).	
(22) International Filing Date: 13 August 1997 (13.08.97)		<p>Published With international search report.</p>	
(30) Priority Data: PO 1636 13 August 1996 (13.08.96) AU			
(71) Applicant (for all designated States except US): EVEREADY BATTERY COMPANY, INC. [AU/AU]; 25225 Detroit Road, Westlake, OH 44145 (US).			
(72) Inventors; and (75) Inventors/Applicants (for US only): DALTON, David, Richard [AU/AU]; 19 Stonecrop Road, North Turramurra, NSW 2074 (AU). BROWN, John, Robert [NZ/AU]; 52 Rangers Avenue, Mosman, NSW 2088 (AU). MARTENS, Gregory, Michael [AU/AU]; 41/116 Herring Road, Marsfield, NSW 2122 (AU).			
(74) Agent: FREEHILLS PATENT ATTORNEYS; MLC Centre, Level 34, Martin Place, Sydney, NSW 2000 (AU).			

(54) Title: LIGHTING DEVICES E.G. BICYCLE LAMPS



## (57) Abstract

A portable lighting device (such as a bicycle lamp) may include the following: an arrangement (illustrated) of light emitting diodes (38, 40, 42) at different angles to each other so that light can travel in at least two directions away from the lighting device; use of multiple images of at least one light emitting diode to present a more visible effect from one or more light emitting diodes; a body portion which will glow when internally generated light falls upon it; a main lamp and openings or channelling means so that light is also emitted from side portions; faired surfaces to facilitate the use of the lighting device in more than one situation; or a lens section having at least two side portions in optical communication with a light emitting diode.

**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

## LIGHTING DEVICES E.G. BICYCLE LAMPS

### FIELD OF THE INVENTION

The present invention relates to lighting devices, such as those devices for use with bicycles, to illuminate a roadway or to emit light from the rear of a bicycle to warn drivers of motor vehicles or attract their attention.

### BACKGROUND OF THE INVENTION

Throughout the specification the term "lens" or "lens portion" or "lens section" is used to define a formation of translucent material which may or may not be transparent and which may or may not influence or refract or diffract light which passes through the formation. Preferably the material which the lens is manufactured from is a plastics or polymeric material.

Bicycle lights are manufactured in many varieties such as the type with a lamp of the halogen, xenon, other gas or vacuum type or, as is becoming more popular, light emitting diode (except in the passages headed "Summary of Invention" and the claims, light emitting diode(s) will hereinafter be referred to as "LED(s)") bicycle lights for use at the rear of the bicycle.

Prior art LED bicycle lights have a relatively narrow spread of the light emitted from the LEDs, making them difficult to identify by people travelling in a direction which is not directly behind the bicycle, or a direction towards the bicycle but also not directly behind it. This difficulty with LED type rear lights means that when a bicycle having the lighting device is turning, the light from the LEDs is not readily seen by drivers of cars not directly behind the bicycle, nor by drivers turning into a path at the rear of the bicycle. Thus LED prior art bicycle lights can be quite difficult to see from directions other than directly behind the bicycle.

Conventional prior art bicycle lights for the front of the bicycle generally include a lamp which is powered by dry cells. These lights also tend to be directional and low powered such that people or drivers of cars at the sides of the bicycles cannot see the beam of light being emitted. Another disadvantage, when being viewed from the front, is that because the lights are generally battery operated, the power source is relatively stable and the light whilst lighting the road ahead, may not necessarily warn an on-coming driver of a vehicle that a bike rider is present.

Conventional prior art bicycle lights are generally detachable from a mounting bracket so that they won't be stolen and need not be left in the weather outdoors. Also they can be readily removed for use as a flashlight. However, the mounting portions of such conventional prior art lights, which engage a mounting bracket, when held in a users hand, because of the presence of sharp features, may injure the skin of a user's hand or fingers. It is also possible for the mounting portions to tear or otherwise damage the material of a glove covering a user's hand. Such prior art bicycle lights tend not to be readily graspable because of obstructions to the user's grip, caused by the mounting portions which detach with the light from the mounting bracket.

## **OBJECTS**

It is an object of the present invention to ameliorate, at least in part, at least one of the disadvantages of the prior art.

## **SUMMARY OF THE INVENTION**

The invention provides a lighting device including a body portion having a holding means to hold a portable electricity supply and control circuitry to power at least two light emitting diodes, said lighting device including a lens portion having at least one lens sections, or at least as many lens sections as there are light emitting diodes, which receive light from said diodes or respective ones of said diodes, said at least two diodes being arranged so that there is an angle between the direction of light emitted from one diode relative to the direction of light emitted from at least one other diode, said lens sections being arranged so that light emitted from said diodes passing through said lens section(s), travels in at least two directions away from said lighting device.

Preferably the angle between said directions is  $10^{\circ}$  to  $90^{\circ}$ .

Preferably said at least two directions are defined by means of one of the following: an imaginary central axis of a cone of light which is emitted from each of said at least two diodes; longitudinal axes of said at least two diodes; directions of axes normal to the surfaces of mounting portions which receive said at least two diodes.

Preferably said lens section(s) has(have) one multi-faceted side.

Preferably said facets are of a triangular, square, rectangular or other polygonal shape.

Preferably there are at least three lens sections and at least three light emitting diodes.

Preferably at least two facets of each lens section direct light passing through said lens section in different or parallel directions to each other.

Preferably at least two light emitting diodes have a cone angle of emitted light of approximately 50°.

Preferably said lens portion includes a wall extending away from said lens section(s), such that an end of said wall portion is engageable with said body portion.

Preferably one of said lens portion and said body portion includes a seal means to at least substantially seal areas of engagement of said lens portion and said body portion.

Preferably a printed circuit board embodying said control circuitry is permanently attached to said lens portion.

Preferably said wall portion is adapted to glow when said at least two diodes emit light.

Preferably said wall portion glows when internally reflected light or light emitted from said diodes strikes said wall portion.

Preferably said wall portion is made from acrylic with a frosted finish.

Preferably said frosted finish is on an internal surface of said wall portion.

Preferably said control circuitry powers said at least two diodes in one or more of the following modes: alternately; simultaneously; randomly; or by said diodes being powered in groups alternately or randomly.

Preferably said lighting device is adapted to be secured to the front or rear of a moving object such as a person, a bicycle or other vehicle.

Preferably said lighting device is adapted to be hand held.

Preferably said lighting device is a bicycle light.

The features of this embodiment of the invention provide a multi-directional rear light and in the embodiment having 3 LEDs, one can be directed directly to the rear, and the other two, to directions at angles either side thereof. Because of this, the lighting device is more visible when a rider puts pressure on a crank causing the frame to oscillate from side to side in a direction perpendicular to the direction of motion. Further, when a rider is turning a corner or if a car is at an angle other than directly at the rear, such as when in an overtaking situation, one of the other side LED lights will help illuminate the bicycle and hopefully alert the driver of the vehicle at the rear.

If hand held, the lighting device of this embodiment, because of the angular coverage of the light emitted, should be more readily seen from different angles.

The invention also provides a lighting device having a body portion for housing a portable electricity supply and an associated control circuitry to power at least one light emitting diode to act as a light source, said lighting device having a lens portion with at least one lens section which includes at least one multi-faceted portion, which is preferably highly polished, so that light emitted from each diode passes through a corresponding lens section so that through each facet said light can pass out of said lighting device whereby when said at least one light emitting diode is viewed from a position on the other side of said lens portion to said light emitting diodes, there are seen multiple sources of light or multiple images of said at least one light emitting diode.

Preferably there are three of said lens sections and three light emitting diodes.

Preferably said lens sections, when there is more than one, are at least part circular and together form a multifaceted lens extending substantially across a substantial width of said lens portion.

Preferably the facets of said lens sections are of a triangular or polygonal shape.

Preferably said lighting device is a bicycle light.

By providing the multifaceted lens, the embodiment allows a greater number of images of the light source to be viewed from the rear through each facet of the multi-faceted lens section. This

gives a more recognisable effect and one that can bring the light source to the attention of a potential viewer.

The present invention further provides a lighting device having a body portion for housing a portable electricity supply and associated control circuitry to power at least one light emitting diode so that it acts as a light source, said lighting device having a lens portion with at least one lens section at one end of said lens portion and a wall section depending from said lens portion, said wall section having a frosted or translucent surface so that any light emitted from said diode which does not pass through said lens section or portion, or is internally reflected therefrom, will diffuse through said wall section or is internally reflected in said wall section and subsequently passes through it, giving the wall section a glowing or illuminating appearance.

Preferably the frosted surface helps to reflect light across the surface and to eventually pass said light through said frosted wall section.

Preferably said frosted surface enables said wall section to act as a light pipe.

Preferably said frosted surface is produced by means of a chemically etched finish or spark eroded finish on the mould tool.

Preferably a frosted finish is applied to or formed on either an inside or outside surface of the wall section.

Preferably said frosted finish completely covers an inside or outside surface of said wall section.

Preferably said lighting device is a bicycle light.

This embodiment of the invention produces a glowing wall between the lens section and the body of a lighting device which can be additional to any light emitted from light emitting diodes through the lens section. Because the wall section can glow, the lighting device may be visible from directions which are not in the general directions of light emitted from the diodes through the lenses. Such directions can include the side and to a smaller degree from a sideward and frontward position.

The invention also provides a lighting device having a body portion for housing a portable electricity supply, associated control circuitry and switching means connected in circuit with a lamp holder in which can be mounted a lamp means, said lighting device also including a lens section and a reflector portion, said lens section including a front portion and at least two side portions extending away from the front portion, said reflector portion including at least two openings or channelling means to allow light to travel from said filament to said at least two side portions, so light can be emitted, through both of said generally planar front portion and said at least two side portions.

Preferably said side portions are positioned so that an imaginary straight line can be drawn through said side portions and a filament of said lamp means when positioned in said lamp holder.

Preferably each side portion is in light or optical communication with a light emitting diode so that when said diodes emit light, said light is visible through said side portions.

Preferably said light emitting diodes are positioned adjacent said side portions.

Preferably said light emitting diodes are amber colour.

Preferably said diodes are red, when utilised for locations other than a forward direction on said bicycle.

Preferably said light emitting diodes can emit light which is also visible through said front portion of said lens section.

Preferably an opening means is provided in said reflector portion to allow said light emitted from said diodes to be visible through said front portion of said lens section.

Preferably said front portion is surrounded by a periphery with a frosted finish so that when it is lighted the periphery is visible from at least a forward position.

Preferably said switching in said associated circuitry allows one of the following modes to be selected:

- (a) a non intermittent emission of light from a lamp means mounted in said holder; or



- (b) the intermittent powering of said light emitting diode; or
- (c) the constant powering of said lamp means in the lamp holder simultaneously with intermittent powering of said diode so that a constant light beam is emitted whilst at the same time a flashing light from the sides and front is visible.

Preferably said frosted finish acts as a light pipe so that said side portions and said periphery illuminates or glows when said lamp means is emitting light and or when said diodes emit light.

Preferably said lighting device is a bicycle light.

One of the advantages of this embodiment is that it allows at least two modes of operation so that better road visibility and or better recognition or awareness by drivers of oncoming vehicles results.

Because the LEDs are preferably flashing, they can provide a piercing, attention getting signal in difficult weather such as rain or fog or other low lights situations.

Because of the side portions allow a constant lamp light or flashing LED light, or both, to be emitted sideways of the direction of movement, there is a greater chance of the lighting device being observed from angles other than just in front of the light. This can be particularly helpful when T intersections are being passed, with a car waiting at the leg of the T intersection, or when bicycles with such lighting devices or cars are in the action of turning.

The invention also provides a bicycle light having a body portion and a lamp portion, the bicycle light being characterised by the presence of a mounting bracket receiving portion which is adapted to receive a mounting bracket; said mounting bracket portion having faired surfaces tapering from the side peripheries of said bicycle light to form a recess which is adapted to receive said mounting bracket.

Preferably said mounting bracket receiving portion has a ledge or surface between an end of the mounting bracket receiving portion and an end of the bicycle light.

The advantage of this embodiment is that a faired mounting bracket receiving recess in said bicycle light body portion is formed. This allows a more comfortable grip for a user when the

bicycle light is removed from the bicycle and is then used as a hand held flashlight to light the way of a walking bicycle rider.

The invention further provides a lighting device having a body portion for housing a portable electricity supply, associated control circuitry and switching means connected in circuit with a lamp holder in which can be mounted a lamp means, said lighting device also including a lens section and a reflector portion, said lens section including a front portion and at least two side portions extending away from the front portion, each side portion being in light communication or optical communication with a light emitting diode so that when said at least one light emitting diode emits light, said light is visible through said side portions.

Preferably there are two light emitting diodes each one being positioned adjacent a respective said side portion.

Preferably each of said light emitting diodes emits an amber coloured light.

Preferably said diodes are red, when utilised for locations other than a forward direction on said bicycle.

Preferably said light emitting diodes can emit light which is also visible through said front portion of said lens section.

Preferably an opening means is provided in said reflector portion to allow said light emitted from said diodes to be visible through said front portion of said lens section.

Preferably said front portion is surrounded by a periphery with a frosted finish so that when it is lighted the periphery is visible from at least a forward position.

Preferably said switching in said associated circuitry allows one of the following modes to be selected:

- (a) a non intermittent emission of light from a lamp means mounted in said holder; or
- (b) the intermittent powering of said light emitting diode; or

- (c) the constant powering of said lamp means in the lamp holder simultaneously with intermittent powering of said diode so that a constant light beam is emitted whilst at the same time a flashing light from the sides and front is visible.

Preferably light from said lamp means and said light emitting diodes can be visible simultaneously through said side portions and or through said front portion of said lens.

Preferably said lighting device is a bicycle light.

The foregoing statements of inventions describe inventions of two forms of lighting device.

There are also described features which at this time are only preferable. However, at some later time it may be necessary to combine one or more of the inventions of the two forms of lighting device, or make essential one or more of the preferable features, to distinguish these inventions from prior art which is unknown at the time of writing this specification and which may become known in the future.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

Embodiments of the present inventions will now be described, by way of example only, with reference to the accompany drawings in which:

Fig 1 illustrates a side view of a bicycle lighting device:

Fig 1A illustrates a perspective rear view of the apparatus of Fig 1 with the mounting bracket removed;

Fig 1B illustrates a perspective front view of the apparatus of Fig 1 with the mounting bracket removed;

Fig 2 illustrates a top view of the apparatus of figure 1;

Fig 2A illustrates a bottom view of the apparatus of figure 1;

Fig 3 illustrates a front view of the apparatus of figure 1;

Fig 3A illustrates a rear view of the apparatus of figure 1;

Fig 4 illustrates a cross section through the apparatus of figure 1 through the lines IV-IV;

Fig 5 illustrates a cross section through the apparatus of figure 2 through the lines V-V;

Fig 6 illustrates a view looking inside the lens in the direction of arrow VI of Fig 5;

Fig 7 illustrates a forward perspective of a bicycle lighting device;

Fig 8 illustrates an underneath perspective of the apparatus of figure 7;

Fig 9 illustrates an underneath plan view of the apparatus of figure 7;

Fig 10 illustrates a plan view of the apparatus of figure 7;

Fig 11 illustrates a front view of the apparatus of figure 7;

Fig 12 illustrates a rear view of the apparatus of figure 7;

Fig 13 illustrates a right side view of the apparatus of figure 7;

Fig 13A illustrates a left side view of the apparatus of figure 7;

Fig 14 illustrates a cross section through fig 13 along line XIV-XIV;

Fig 15 illustrates a cross section through fig 12 along line XV-XV; and

Fig 16 illustrates a cross section through fig 13 along line XVI-XVI.

## **DETAILED DESCRIPTION OF THE EMBODIMENTS**

Illustrated in figures 1 to 6 is a lighting device 2 which is designed for attachment to the rear of a bicycle. The lighting device 2 includes a lens portion 4 having a closed continuous walled section 6 which extends away from body 8 and surrounds or bounds an enclosed space. The walled section 6 terminates at one end which includes the surfaces of the lens section 10, and at the other end with a shoulder 28 to receive a moulded holder 33. The lens section 10 has a bulging and curved (or convex when viewed from the outside) outer surface 12, as viewed in fig 1. The generally convex outer surface 12 has an overall generally concave inner surface 14 when seen in cross section, as in fig 4, but because it is formed in part from the convex lens sections 18, 20 and 22, the inner surface 14 does have a convex appearance when viewed in cross section as in fig 5. The inner surface 14 includes, as part of its construction a series of

facets 16. These facets 16 are more clearly visible in fig 6 which is a view in the direction of arrow VI as illustrated in fig 5.

Referring now to figures 4 and 6, the inner portion 14 is made up of three multi-faceted lens sections or lenses 18, 20 and 22, each of which has formed thereon a series of triangular facets 16. Each of the facets 16 on the multi-faceted lenses 18, 20 and 22 is preferably highly polished to maximise transmission and minimise reflection of light by the multi faceted lenses 18, 20 and 22. This will allow as much light as possible, to travel from the inner surface 14 to the outer surface 12. Alternatively, the multi-faceted lenses 18, 20 and 22 can be given a frosted finish, but such a frosted finish will reduce the brightness of the light transmitted through the lens sections 18, 20 and 22.

The lens portion 4 can be manufactured by injection moulding from an acrylic material. The smoothness of the moulds in the vicinity of the lenses 22, 20 and 18 and the outer surface 12 results in the moulded product having the highly polished finish. The walled section 6 is produced so that the internal surfaces 24 (see fig 4) around the lens portion 4 result in a frosted finish. The frosted finish is produced by a spark eroded or chemically etched mould surface to form the internal surface 24, .

The frosted finish results in light hitting the internal surface 24 being diffused or transmitted through the walled section 6. Alternatively, it may be internally reflected in the wall 6 until it diffuses or otherwise exits from the wall 6. In this way, the walled section 6 acts as a light pipe. The frosted finish of the internal surface 24 will make the walled section 6 appear to glow when any internally reflected light or other light hits the surface 24 travelling in the direction from inside of the surface 24 to the outside. When this is coupled with the LED light projected through lenses 18, 20 and 22, the lighting device 2 can have a visibility field of approximately 270°.

When the walled section 6 glows, the walled section 6 becomes visible at night time.

The lens portion 4 has a terminus 26 around the length of the periphery of the walled section 6. The terminus 26 includes a shoulder 28 peripherally located thereon. The shoulder 28 provides a

mounting point for a moulded holder 33 which holds a printed circuit board 30. The shoulder 28 also provides the necessary contact between the moulded holder 33 and the shoulder 28 so that they can be sonically welded or otherwise joined together.

Mounted on the printed circuit board 30 are three LEDs 38, 40 and 42. The LED 38 is positioned so that it points in a direction so that light emitted from the LED 38 will pass through the multi-faceted lens 18. Likewise with LED 40 and multi-faceted lens 20; and LED 42 and multi-faceted lens 22. The LEDs 38, 40 and 42 are of the 3000 mcd type which operate at 3 volts. Generally once the LEDs 38, 40 and 42 are positioned, they are not easily replaceable because they are soldered into the printed circuit board 30. It may be that an LED holder exists which would allow for the ready replacement of the LEDs. If such exists, it can be used instead of soldering.

It can be seen from Fig 4 that the LEDs 38, 40 and 42 are located and secured by means of a three angle formation or bracket 41. The three planar mounting surfaces of the bracket 41 have an angle between them which is measured between a direction normal to each of the three mounting surfaces. These directions are approximated by the directions indicated by the dimensions or distances 36 from the diodes to the lenses in figure 4.

The bracket 41 is a part of or is secured to the printed circuit board 30 so that when the LEDs 38, 40 and 42 are installed onto the printed circuit board 30, which is to be secured to the walled section 6, the LEDs are at the correct angle and alignment to emit light through the lenses 18, 20 and 22.

The distance from the LED 38, 40 and 42 to the multi-faceted lenses 18, 20 and 22 is dictated by the cone angle of light which is emitted from the LEDs 38, 40 and 42. The LEDs 38, 40 and 42 preferably have a cone angle of  $50^\circ$ . This cone angle dictates that the distance 36 is approximately 30 millimetres. This distance 36 of 30 millimetres ensures that the 50 degree cone angle of light emitted from LEDs 38, 40 and 42 is such that the periphery of the cone of that light, when it hits the multi-faceted lenses 18, 20 and 22, has approximately the same diameter as the multi-faceted lenses 18, 20 and 22. Whilst other cone angled LEDs such as  $14^\circ$  and  $30^\circ$

can be utilised, the present invention operates best with a 50° cone angle. If other cone angled LEDs are utilised, other modifications will be required, such as a lengthening of the distance 36, or a decrease in the size of the lenses 18, 20, and 22.

When the facets 16 of the multi-faceted lenses 18, 20 and 22 are highly polished, a person who views the light emitted by the LEDs, via the lenses 18, 20 and 22, will see as many glowing images of the light as there are facets in the lenses 22, 20 and 18. By the facets 16 being of a relatively large size (equilateral triangles having each side approximately 5 mm to 7 mm in length), distinct images of light can be transmitted through the facets giving a multiplying effect of the images of light being emitted. Preferably the light passing through the facets 16 on each of the lenses 18, 20 and 22 is such that the light will travel out through each of the respective lenses 18, 20 and 22 in a conical fashion. However, angles between the directions of light emitted from the lenses 18, 20 and 22 can be different and this is dictated by the angles of the facets 16. The angles of the facets 16 relative to each other can be set so that light passing through individual facets 16 of each of the respective lenses 18, 20 and 22 is substantially parallel to other light travelling through the same lens 18, 20 or 22.

The facets 16 can be located on the outside of the lighting device 2. However, they are preferably located on the inner surface 14, as is illustrated in the figures, as it has been determined that this is a better location as far as the resultant effect is concerned. The facets 16 are viewable from outside of the lighting device 2.

The body 8 of the lighting device 2 is attached to the moulded holder 33 by means of a set screw 50 which engages a threaded portion 51 on the moulded holder 33. This set screw 50 is also illustrated in figure 1A which is a rear perspective of the lighting device 2. When the set screw 50 is removed, the body 8 can be separated from the printed circuit board 30 and the lens portion 4. In this way, access can be gained to the dry cell mounting portions 52, so that dry cells 54 (see fig 5) can be removed or installed. The printed circuit board 30 has a groove 56 around its periphery, which allows it to receive a seal 58, which is shown in position in the groove 56 in figure 5. The seal 58 is not present in figure 4.

A switch actuator 44 is linked to a switching mechanism 48 mounted on a printed circuit board 30. The control circuitry included in the printed circuit board 30 can be designed so that various modes of operation and illumination of the LEDs 38, 40 and 42 can occur. For example if the switch in mechanism 48 was a four position switch, then the LEDs may be controlled to: power on or off alternately, so that as one switches on, the other switches off, and so on; all three LEDs can be made to flash on and off at the same time; groups of flashing LEDs can be made to illuminate so that at any one time groups of two LEDs 38 and 40 then 40 and 42 then 42 and 38 illuminate and so on, or all three at once; or all LEDs are randomly switched on and off, which may also include randomly powering on and off the LEDs in groups.

If desired, the control circuitry can include an override feature which may be activated by the application of brakes on the bicycle. If the brakes are applied, a switch mechanism can, directly or indirectly, be closed. In which case, the LEDs cease flashing either alternately, randomly or otherwise and stay on steadily, so as to indicate to a person behind the bicycle that the rider is braking.

The LEDs 38, 40 and 42 are preferably flashing when in use, that is not continuously powered, but intermittently powered, so that the flashing LEDs will help attract attention. Such flashing also helps to conserve electricity stored in the dry cells, thereby resulting in extended life.

The three LEDs 38, 40 and 42, when seen in plan view, occupy three different angular positions. The angles 37 and 39 are each of a value of  $30^{\circ}$  to  $45^{\circ}$ , when viewed from the side in cross-section, as in figure 5. From figure 5, it can also be seen that the LEDs 38, 40 and 42 each have their central axes lying in substantially the same plane. The angular arrangement and directions of light emission of the LEDs enables a bicycle fitted with such a lighting device to be visible from a greater range of angles by comparison with previous bicycle lights. The light from the LEDs 38, 42 (and thus a bicycle to which the lighting device 2 is attached), because the light is directed to the side, can be viewed as the angle of the bicycle changes relative to the ground, which can occur when the bicycle is swaying from side to side, as a person is pedalling or standing on the pedals, or is banked as the bicycle turning.



If desired other LEDs can be present, such as two more, one mounted below LED 40 and one mounted above LED 40. Such additional LEDs will require commensurate additions of multi-faceted lenses and an increase in the body dimensions. The additional LEDs can be oriented to direct light at an angle in the range of approximately  $30^\circ$  to  $45^\circ$  (or at a smaller angle) above and below the plane in which the other LEDs 38, 40 and 42 lie. By such additional LEDs, light can be emitted in a further two directions thus giving an even greater chance of being viewed. Thus truck drivers who are seated in generally higher positions by comparison to car drivers, will be able to view the light in addition to car drivers and drivers of small cars who are even lower to the ground.

If desired, other arrangements of differing numbers of LEDs can be developed, whereby for example some five LEDs are provided, equi-spaced from  $0^\circ$  to  $180^\circ$ , so that light is emitted in directions at  $90^\circ$  to the axis 72 of fig 4. If only two LEDs are utilised they are preferably separated by an angle less than  $30^\circ$  to give adequate coverage to the rear, and improved coverage at other angles, by comparison to the prior art.

The body 8 includes a passage 34 for the switch actuator 44 to pass through it to activate a switch mechanisms 48, mounted on the circuit board 30. The passage 34 is sealed by a sealing diaphragm 46 so that water does not have a path into the internal portions of the body 8.

The rear end 60 of the body 8 includes an attachment portion 62 which allows a mounting bracket 64 to be connected to the lighting device 2, by means of strap 66 and clasp 68 which secure the lighting device 2 below the seat of a bicycle, onto to a tubular saddle support. The mounting bracket 64 preferably has a realisable securing mechanism 70, which allows the user of the lighting device 2 to adjust the height and/or direction to which the LED is directing light. The clasp 68 and strap 66 allow the user to orient the centre line 72, through the centre LED 40, parallel to a longitudinal direction of the bicycle, to which this is attached.

While the above indicates that the lens section 10 has 3 lenses 18, 20 and 22, the lens section 10 can be manufactured so that there is only one multi-faceted lens across the whole width and height of the lens section 10, whereby only one lens will be discernible in the lens section 10.

It is readily understood that the lighting device 2, without the mounting bracket 64, is useful as a hand-held lighting device so that persons who may be lost at night time might attract attention. It is also readily understood that other mounting mechanisms can be utilised for attachment of the lighting device to a person's body or even to the rear or other location of a person's head.

Illustrated in figs 7 to 16 is a lighting device 80 which can be for the front or rear of a bicycle. The lighting device 80, whether for front or rear use on a bicycle, has some common features. The majority of the following features are common to front and rear usage, and the differences will be discussed later.

The lighting device 80 has an elongated "dog leg" shaped body portion 82 which includes a top segment 84 and a lower segment 86. The top and lower segments 84 and 86 are similarly shaped in parts thereof with the top segment 84 including a generally flat upper surface with rounded sides. Whereas, the lower segment 86 is also generally streamlined though not flat, with rounded sides. The lower segment 86 acts as a dry cell housing cover and is secured to the top segment by means of a set screw 88. In the vicinity of the head of the set screw 88 is a formation or fairing 135 which, for aesthetic purposes, partially surrounds the head of the set screw 88.

To install or remove the dry cells, the lighting device is turned upside down so that lower segment 86 is on top. The set screw 88 is turned or removed and then lower segment 86 is able to be separated from top segment 84, allowing a user to gain access to the dry cells 92 or dry cell housing (as illustrated in fig 14).

The body 82 has a section 90 which houses dry cells 92 (as illustrated in Figure 14) and a printed circuit board region 94 which is located adjacent to the dry cells holding area 96. The printed circuit board 95, in region 94, is located generally beneath a main lamp on/off switch 98 and an LEDs on/off switch 100. The switches 98 and 100 close two independent circuits, one for the main lamp and one for LEDs.

In the same region as the switches 98 and 100 is a dry cell life indicator 102 which is connected in the control circuitry which is designed to illuminate the dry cell life indicator when the dry cell life has been reduced to 30%. The dry cell indicator can glow green by means of a green

LED (not illustrated) when greater than 30% life remains or red by means of a red coloured LED (not illustrated) when dry cell life is 30% or less compared to when fully charged.

Extending away from and adjacent to the printed circuit board 95 is lamp end 104 which includes a centrally mounted lamp holder mechanism 106 which holds a lamp 108. The lamp holder 106 is connected into the tracks and circuit connections provided in the printed circuit board 95 so as to provide electric power to illuminate the lamp 108. Surrounding the lamp 108 is a reflector 110 which is enclosed by a lens 112 which is of a highly polished, clear finish.

Around the periphery of the lens 112 is a peripheral portion 114, which is integrally moulded but has a manufactured frosted finish. Generally the lens 112 and the periphery 114 are manufactured from acrylic and the frosted finish is achieved by a mould surface being spark eroded or alternatively chemically etched, so that a frosted finish results.

Extending from the lens 112 back along the lamp end 104 are side lenses 116. The side lenses 116 are either integrally formed with the lens 112 or alternatively are separately formed but are optically connected.

The relationship between the side lenses 116 and the lamp 108 is more clearly depicted in Figure 14.

As is illustrated in Figure 14 the filament 118, when the lamp 108 is in the holder 106, is in a position which is in line with two apertures 120 at diametrically opposite portions of the reflector 110. The apertures 120 need only be apertures to achieve the desired result. But if desired extending from the apertures 120 there can be located reflective channels 122 which direct light from the filament 118 to the internal surfaces of the side lenses 116. When light passes from the filament 118 through aperture 120 and through channels 122 onto the inner surface of the side lenses 116, because the side lenses 116 are of a frosted finish, some light is internally reflected and transmitted from this location around to the peripheral portion 114 whereas some light passes out of the side lenses 116. The frosted finish on side lenses 116 and peripheral portion 114 together act as a light pipe to channel light in both directions depending on the source. Thus when the lamp 108 is illuminated, light can be seen from the side of the

lighting device 80 because of the side lenses 116 receiving and transmitting light from lamp 108. Further, as the periphery 114 is also alight, a rider can determine that the lighting device 80 has been switched on by looking at the lighting device 80 from above rather than from in front.

The peripheral portion 114 can also be lighted by means of light emanating from the front lens 112 entering the peripheral portion 114, which then pipes or conducts some of the light to the other frosted portions of the side lenses 116 or other portions of the peripheral portion 114.

Located next to the channels 120 are two LEDs 124 which make optical connection with or are in light communication with the base 126 of the side lenses 116.

Preferably the LEDs are amber in colour because generally red LEDs indicate the rear of objects such as bicycles and other vehicles. Amber colours also have benefits in foggy and rainy weather.

When the amber LEDs 124 are illuminated, by a means of the operator activating the LED on/off switch 100, electrical power is delivered to the LED circuit and makes them turn on and off periodically (i.e. makes them flash cyclically) and act as a warning or other attention attracting signal, which emanates from the side lenses 116. The integral nature of side lenses 116 and periphery 114 which results in the optical connection or light communication between the two together with the presence of a the frosted finish on the side lenses 116 and peripheral portion 114 results in the periphery 114 and side lenses 116 acting as a light pipe. Thus the flashing amber illumination from LEDs 124 not only emanates outwardly from the side lenses 116 but also illuminates the periphery 114 from where the amber illumination is visible when viewed from the front. This can result in the amber flashing of the lighting device 80 being visible to on-coming drivers. Such drivers may not recognise the steady glow of lamp 108, however the flashing amber colour of the LEDs 124 may attract their attention.

The user/rider can select to have either the lamp 108 on constantly, by activating the main lamp on/off switch 98, or in situations where there is sufficient light around for the user/rider, but the rider wants to be visible, the rider can leave the lamp 108 off and switch on the amber LEDs 124 warning lights by means of the LED on/off switch 100. If desired, the user/rider can activate

both the main lamp 108 and the flashing signal of amber LEDs 124, by closing both circuits with switches 98 and 100. In this way maximum visibility of the lighting device 80 is achieved, particularly for any on-coming vehicles, and awareness of the lighting device 80 to other drivers will be greater than if the main lamp alone were switched on.

Alternatively to, or in addition to, the passage of light from the LEDs 124 through the side lenses 116, there can be provided a gap 128 (illustrated in phantom line in fig 14) near the periphery of the reflector 110. The gap 128 is in line with the LED 124 to allow light from LEDs 124 to travel not just through the side lenses 116 and around periphery 114, but also directly out through the front lens 112. This can also add light into the light pipes provided by the frosted finish of the peripheral portion 114.

Even further additional visibility may be gained because of possible internal reflection from the internal side of lens 112 back onto the reflector 110. Thus the flashing may be more clearly seen by oncoming persons or vehicles because it is also emanating from the reflector 110.

The switches 100 and 98 are provided in a recess 130 as illustrated in the cross-section of Figure 15. This recess helps prevent the switches 98 and 100 being accidentally activated when placed in a bag or other conveyance or receptacle.

The lower segment 86 includes a mounting bracket engagement portion 132 which is provided with tapered or faired formations 134 on either side of the mounting bracket engaging portion 132. The smooth formations form a faired structure around the mounting bracket engaging portion 132 so that when a operator choses to grasp the lighting device 80 after it has been taken off the bracket (not illustrated) so as to use the lighting device 80 as a flashlight, there are no corners or relatively sharp portions which engage the user/rider's hands or gloves. By providing the mounting bracket engaging portion 132 in a substantially recessed position, between the tapered or faired formations 134, the lower segment 86 when it sits in a gloved hand or a naked hand, and when pressed from above by the thumb, will allow the flesh at the base of the fingers and at the top of the palm or an outer surface of the glove adjacent thereto to move into and occupy some of the volume of the mounting bracket engaging portion 132. This can provide

some additional grip to help prevent the lighting device 80 from moving out of the bight or space formed between the thumb and fingers of a user/rider.

The faired or tapered rear ends 136 near to each of the tapered or faired formations 134, provide two formations against which the side of a user/rider's little finger can be positioned. That is the user/rider's little finger can lay across the surface 138 of lower segment 86. This helps to provide a comfortable grip when used as a flashlight.

The lighting device 80 of figures 7 to 16 has both the LED and lamp features utilising four AA dry cells. However, this can be modified for particular requirements. These modifications can include not providing the LED circuits but retaining the side lenses 116 so that they illuminate when the lamp means 108 is illuminated.

The size of the dry cell housing can be modified to receive two C-size dry cells or six AA-size dry cells however, as C size or dry cells are thicker or to pack in 6AA-size dry cell requires greater depth if width is held constant, the dimension 140 will be greater for 6-AA or 2 C size dry cells, than that of the four AA version illustrated in the figures.

The difference between the features of the lighting device 80 when used in a rearward position include the following.

For front use, the front lens 112 of the lighting device 80 of figs 7 and 8 is of a highly polished clear finish, whereas for a rearward positioning on a bicycle the clear front lens 112 can be replaced by a red coloured lens so that the light emitted will appear red. Red being generally the colour of rear lights on vehicles.

If desired, the side lights 116, whilst also being of a red acrylic and allowing red light to illuminate from the sides, red LEDs can be installed to generate light to provide a flashing red signal to warn of the presence of the bicycle to drivers of rearwardly approaching vehicles. Alternatively the side lenses 116 can be of a clear acrylic with a frosted surface and used in conjunction with red LEDs. Alternatively still, the LEDs 124 and associated circuit need not be provided at all depending on particular requirements.

While the above embodiment describes two LEDs 124 for each side lens 116, if desired, a single LED could be provided which will communicate light to the side lenses 116 and out through the front lens portion 112, in much the same way as the lamp means 108 does.

The foregoing describes embodiments of the present invention and modifications by those skilled in the art can be made thereto without departing from the scope of the present invention.

**CLAIMS**

1. A lighting device including a body portion having a holding means to hold a portable electricity supply and control circuitry to power at least two light emitting diodes, said lighting device including a lens portion having at least one lens sections, or at least as many lens sections as there are light emitting diodes, which receive light from said diodes or respective ones of said diodes, said at least two diodes being arranged so that there is an angle between the direction of light emitted from one diode relative to the direction of light emitted from at least one other diode, said lens sections being arranged so that light emitted from said diodes passing through said lens section(s), travels in at least two directions away from said lighting device.
2. A lighting device as claimed in claim 1 wherein the angle between said directions is  $10^{\circ}$  to  $90^{\circ}$ .
3. A lighting device as claimed in any one of the previous claims wherein said at least two directions are defined by means of one of the following: an imaginary central axis of a cone of light which is emitted from each of said at least two diodes; longitudinal axes of said at least two diodes; directions of axes normal to the surfaces of mounting portions which receive said at least two diodes.
4. A lighting device as claimed in any one of the previous claims wherein said lens section(s) has(have) one multi-faceted side.
5. A lighting device as claimed in claim 4 wherein said facets are of a triangular, square, rectangular or other polygonal shape.
6. A lighting device as claimed in any one of the previous claims wherein there are at least three lens sections and at least three light emitting diodes.
7. A lighting device as claimed in any one of the previous claims wherein at least two facets of each lens section direct light passing through said lens section in different or parallel directions to each other.



8. A lighting device as claimed in any one of the previous claims wherein at least two light emitting diodes have a cone angle of emitted light of approximately  $50^{\circ}$ .
9. A lighting device as claimed in any one of the previous claims wherein said lens portion includes a wall extending away from said lens section(s), such that an end of said wall portion is engageable with said body portion.
10. A lighting device as claimed in any one of the previous claims wherein one of said lens portion and said body portion includes a seal means to at least substantially seal areas of engagement of said lens portion and said body portion.
11. A lighting device as claimed in any one of the previous claims wherein a printed circuit board embodying said control circuitry is permanently attached to said lens portion.
12. A lighting device as claimed in any one claims 9 to 11 wherein said wall portion is adapted to glow when said at least two diodes emit light.
13. A lighting device as claimed in any one of claims 9 to 12 wherein said wall portion glows when internally reflected light or light emitted from said diodes strikes said wall portion.
14. A lighting device as claimed in any one of claims 9 to 13 wherein said wall portion is made from acrylic with a frosted finish.
15. A lighting device as claimed in any one of the previous claims wherein said frosted finish is on an internal surface of said wall portion.
16. A lighting device as claimed in any one of the previous claims wherein said control circuitry powers said at least two diodes in one or more of the following modes: alternately; simultaneously; randomly; or by said diodes being powered in groups alternately or randomly.
17. A lighting device as claimed in any one of the previous claims wherein said lighting device is adapted to be secured to the front or rear of a moving object such as a person, a bicycle or other vehicle.
18. A lighting device as claimed in any one of the previous claims wherein said lighting device is adapted to be hand held.

19. A lighting device as claimed in any one of the previous claims wherein said lighting device is a bicycle light.
20. A lighting device having a body portion for housing a portable electricity supply and an associated control circuitry to power at least one light emitting diode to act as a light source, said lighting device having a lens portion with at least one lens section which includes at least one multi-faceted portion, which is preferably highly polished, so that light emitted from each diode passes through a corresponding lens section so that through each facet said light can pass out of said lighting device whereby when said at least one light emitting diode is viewed from a position on the other side of said lens portion to said light emitting diodes, there are seen multiple sources of light or multiple images of said at least one light emitting diode..
21. A lighting device as claimed in claim 20 wherein there are three of said lens sections and three light emitting diodes.
22. A lighting device as claimed in any one of claims 20 or 21 wherein said lens sections, when there is more than one, are at least part circular and together form a multifaceted lens extending substantially across a substantial width of said lens portion.
23. A lighting device as claimed in any one of claims 20 to 22 wherein the facets of said lens sections are of a triangular or polygonal shape.
24. A lighting device as claimed in any one of claims 20 to 23 wherein said lighting device is a bicycle light.
25. A lighting device having a body portion for housing a portable electricity supply and associated control circuitry to power at least one light emitting diode so that it acts as a light source, said lighting device having a lens portion with at least one lens section at one end of said lens portion and a wall section depending from said lens portion, said wall section having a frosted or translucent surface so that any light emitted from said diode which does not pass through said lens section or portion, or is internally reflected therefrom, will diffuse through said wall section or is internally reflected in said wall section and subsequently passes through it, giving the wall section a glowing or illuminating appearance.

26. A lighting device as claimed in claim 25 wherein the frosted surface helps to reflect light across the surface and to eventually pass said light through said frosted wall section.
27. A lighting device as claimed in any one of claims 25 or 26 wherein said frosted surface enables said wall section to act as a light pipe.
28. A lighting device as claimed in any one of claims 25 to 27 wherein said frosted surface is produced by means of a chemically etched finish or spark eroded finish on the mould tool.
29. A lighting device as claimed in any one of claims 25 to 28 wherein a frosted finish is applied to or formed on either an inside or outside surface of the wall section.
30. A lighting device as claimed in any one of claims 25 to 29 wherein said frosted finish completely covers an inside or outside surface of said wall section.
31. A lighting device as claimed in any one of claims 25 to 30 wherein said lighting device is a bicycle light.
32. A lighting device having a body portion for housing a portable electricity supply, associated control circuitry and switching means connected in circuit with a lamp holder in which can be mounted a lamp means, said lighting device also including a lens section and a reflector portion, said lens section including a front portion and at least two side portions extending away from the front portion, said reflector portion including at least two openings or channelling means to allow light to travel from said filament to said at least two side portions, so light can be emitted, through both of said front portion and said at least two side portions.
33. A lighting device as claimed in claim 32 wherein said side portions are positioned so that an imaginary straight line can be drawn through said side portions and a filament of said lamp means when positioned in said lamp holder.
34. A lighting device as claimed in any one of claims 32 or 33 wherein each side portion is in light or optical communication with a light emitting diode so that when said diode emits light, said light is visible through said side portions.

35. A lighting device as claimed in any one of claims 32 to 34 wherein there are two light emitting diodes with each diode positioned adjacent respective said side portions.
36. A lighting device as claimed in any one of claims 34 or 35 wherein said light emitting diodes are amber colour.
37. A lighting device as claimed in any one of claims 34 or 35 wherein said diodes are red, when utilised for locations other than a forward direction on said bicycle.
38. A lighting device as claimed in any one of claims 34 to 37 wherein said light emitting diodes can emit light which is also visible through said front portion of said lens section.
39. A lighting device as claimed in any one of claims 34 to 38 wherein an opening means is provided in said reflector portion to allow said light emitted from said diodes to be visible through said front portion of said lens section.
40. A lighting device as claimed in any one of claims 32 to 39 wherein said front portion is surrounded by a periphery with a frosted finish so that when it is lighted the periphery is visible from at least a forward position.
41. A lighting device as claimed in any one of claims 32 to 40 wherein said switching in said associated circuitry allows one of the following modes to be selected:
- (a) a non intermittent emission of light from a lamp means mounted in said holder;
  - (b) the intermittent powering of a light emitting diode;
  - (c) the constant powering of said lamp means in the lamp holder simultaneously with intermittent powering of a light emitting diode so that a constant light beam is emitted whilst at the same time a flashing light from the sides and front is visible.
42. A lighting device as claimed in claim 32 to 41 wherein said frosted finish acts as a light pipe so that said side portions and said periphery illuminates or glows when said lamp means is emitting light and or when a light emitting diode emits light.
43. A lighting device as claimed in any one of claims 32 to 42 wherein said lighting device is a bicycle light.

44. A bicycle light having a body portion and a lamp portion, the bicycle light being characterised by the presence of a mounting bracket receiving portion which is adapted to receive a mounting bracket; said mounting bracket portion having faired surfaces tapering from the side peripheries of said bicycle light to form a recess which is adapted to receive said mounting bracket.

45. A bicycle light as claimed in claim 44 wherein said mounting bracket receiving portion has a ledge or surface between an end of the mounting bracket receiving portion and an end of the bicycle light.

46. A lighting device having a body portion for housing a portable electricity supply, associated control circuitry and switching means connected in circuit with a lamp holder in which can be mounted a lamp means, said lighting device also including a lens section and a reflector portion, said lens section including a front portion and at least two side portions, each side portion being in light communication or optical communication with a light emitting diode so that when said at least one light emitting diode emits light, said light is visible through said side portions.

47. A lighting device as claimed in claim 46 wherein there are two light emitting diodes each one being positioned adjacent a respective one of said side portions.

48. A lighting device as claimed in any one of claims 46 or 47 wherein each of said light emitting diodes emits an amber coloured light.

49. A lighting device as claimed in any one of claims 46 to 48 wherein said diodes are red, when utilised for locations other than a forward direction on said bicycle.

50. A lighting device as claimed in any one of claims 46 to 49 wherein said light emitting diode emits light which is also visible through said front portion of said lens section.

51. A lighting device as claimed in any one of claims 46 to 50 wherein an opening means is provided in said reflector portion to allow said light emitted from said diodes to be visible through said front portion of said lens section.

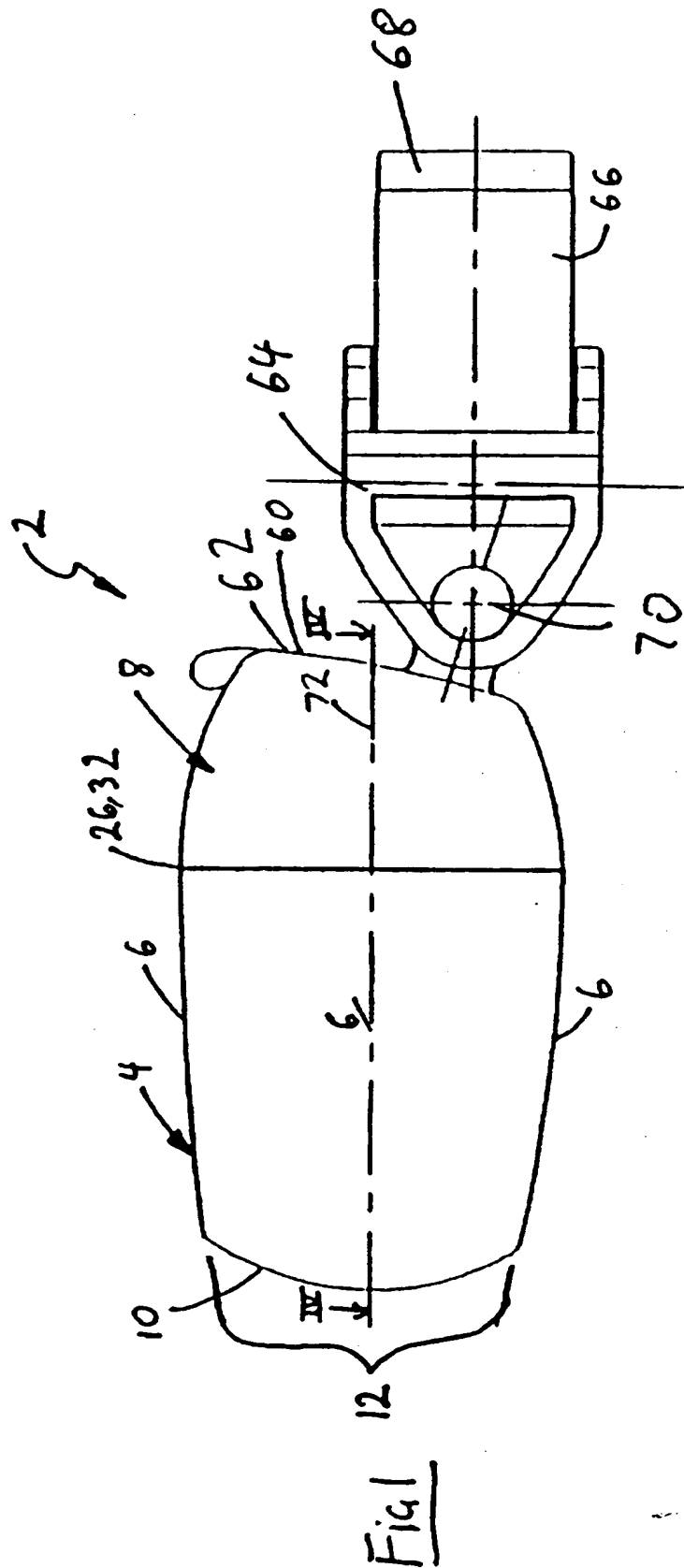
52. A lighting device as claimed in any one of claims 46 to 51 wherein said front portion is surrounded by a periphery with a frosted finish so that when it is lighted the periphery is visible from at least a forward position.

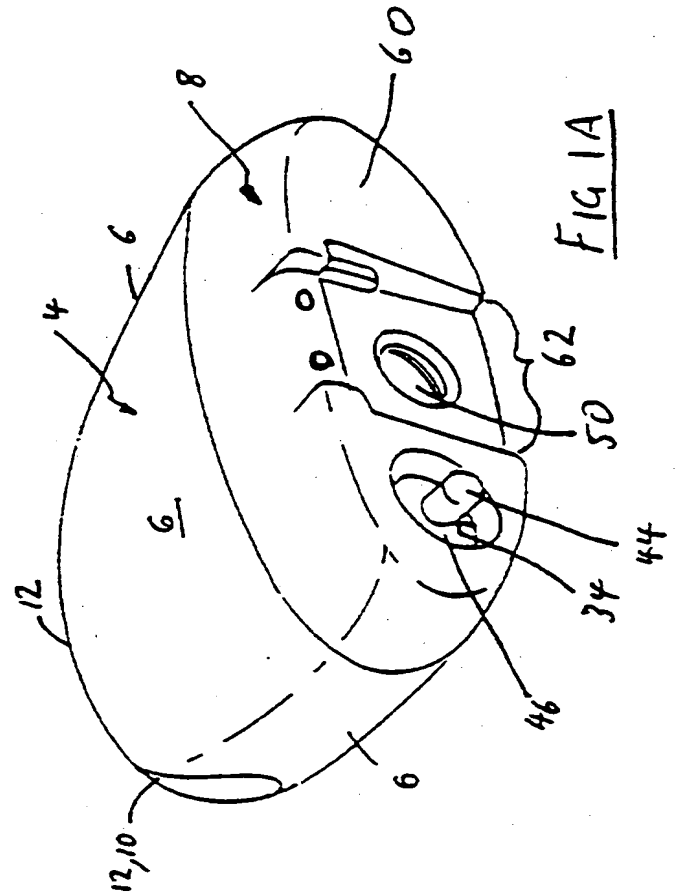
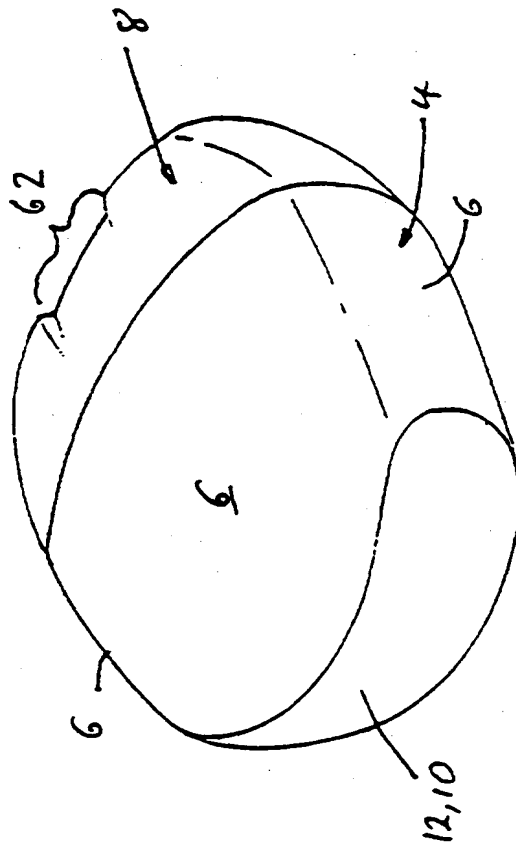
53. A lighting device as claimed in any one of claims 46 to 52 wherein said switching in said associated circuitry allows one of the following modes to be selected:

- (a) a non intermittent emission of light from a lamp means mounted in said holder; or
- (b) the intermittent powering of said light emitting diode; or
- (c) the constant powering of said lamp means in the lamp holder simultaneously with intermittent powering of said diode so that a constant light beam is emitted whilst at the same time a flashing light from the sides and front is visible.

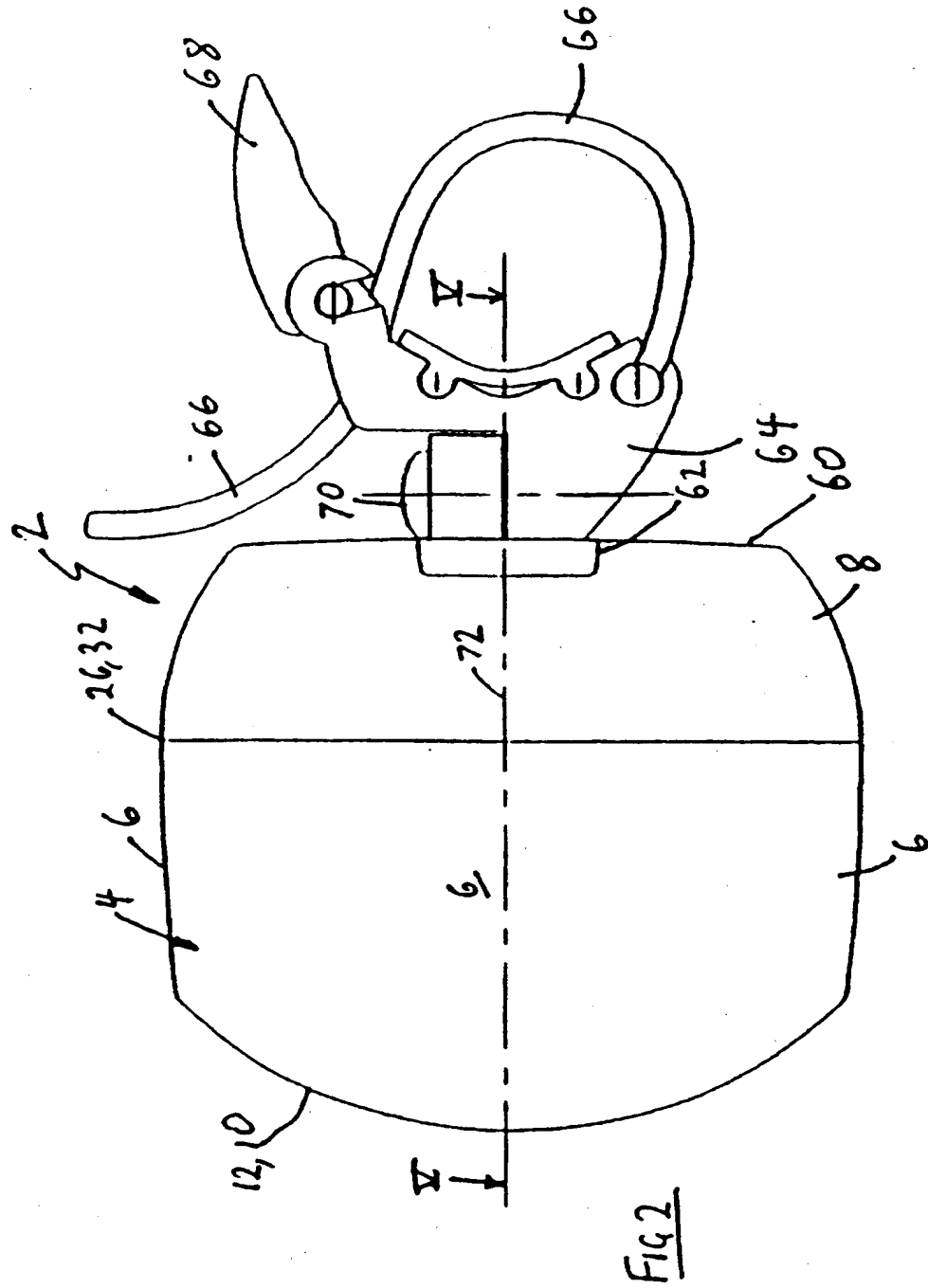
54. A lighting device as claimed in any one of claims 46 to 53, wherein light from said lamp means and said light emitting diodes can be visible simultaneously through said side portions and or through said front portion of said lens.

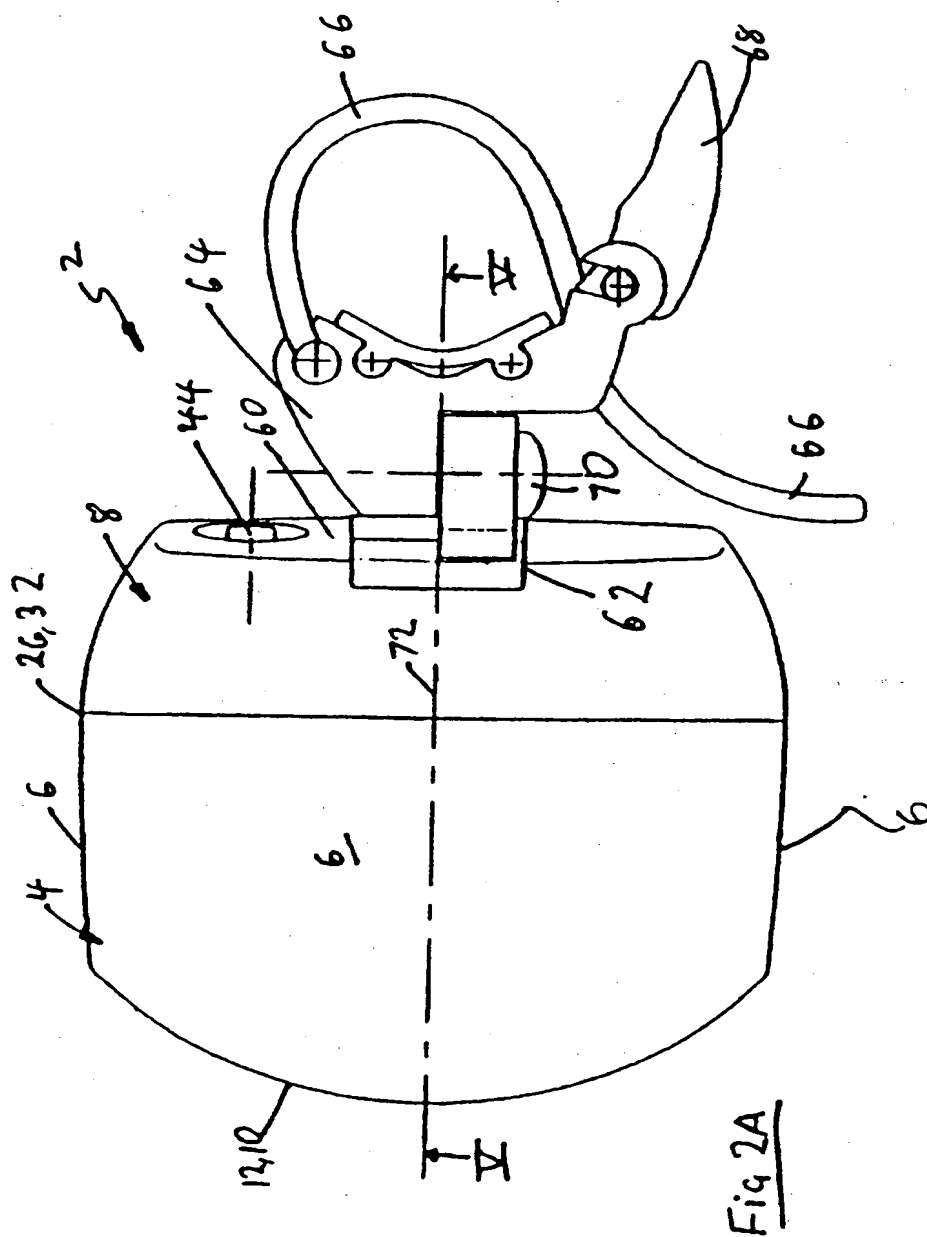
55. A lighting device as claimed in any one of claims 46 to 53 wherein said lighting device is a bicycle light.











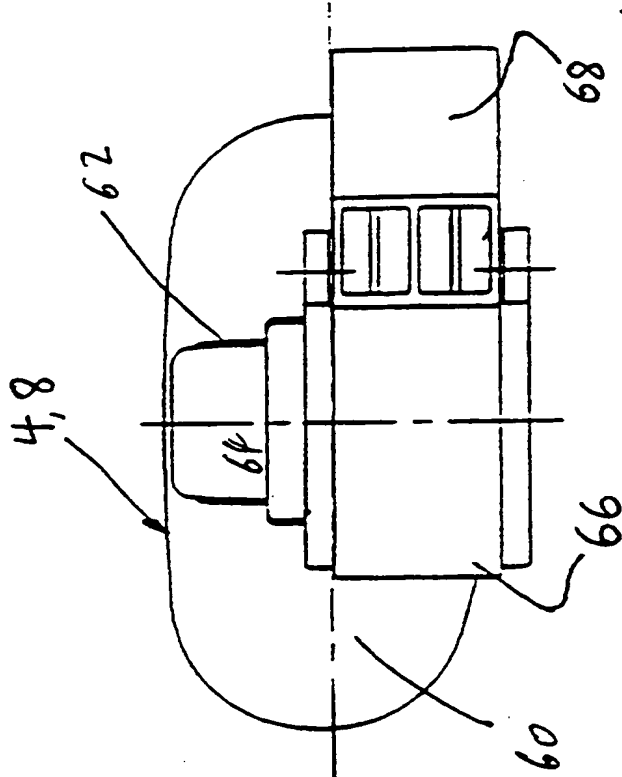


FIG 3A

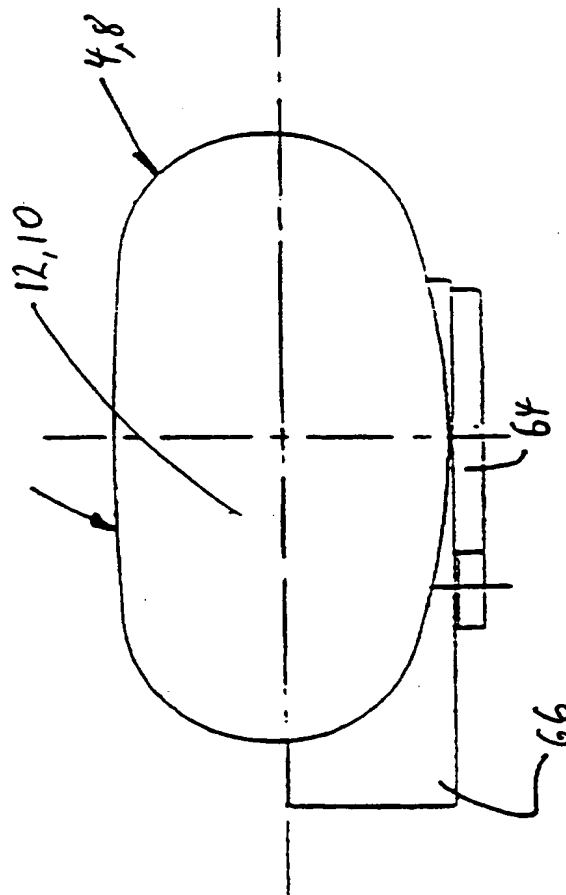
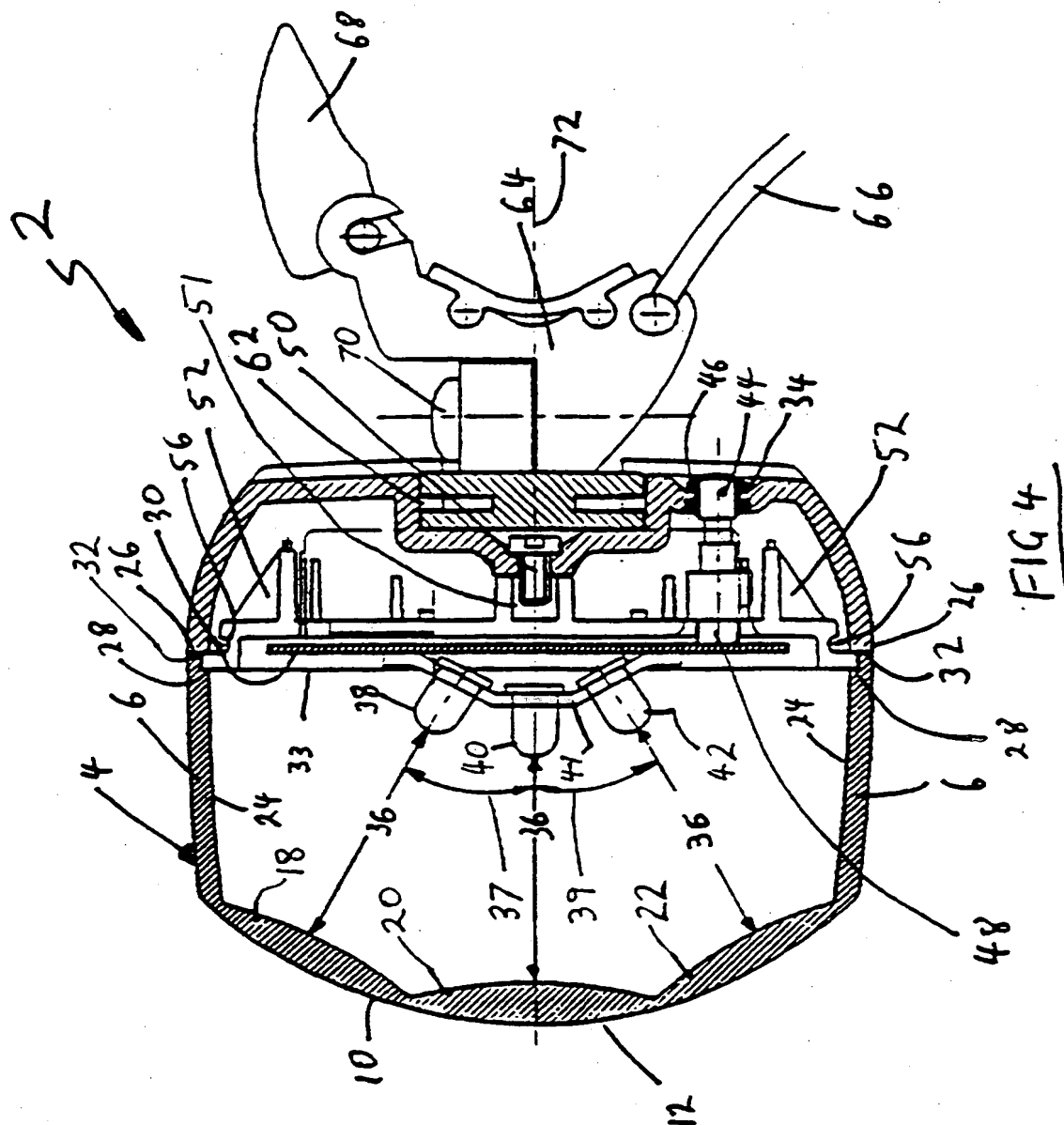
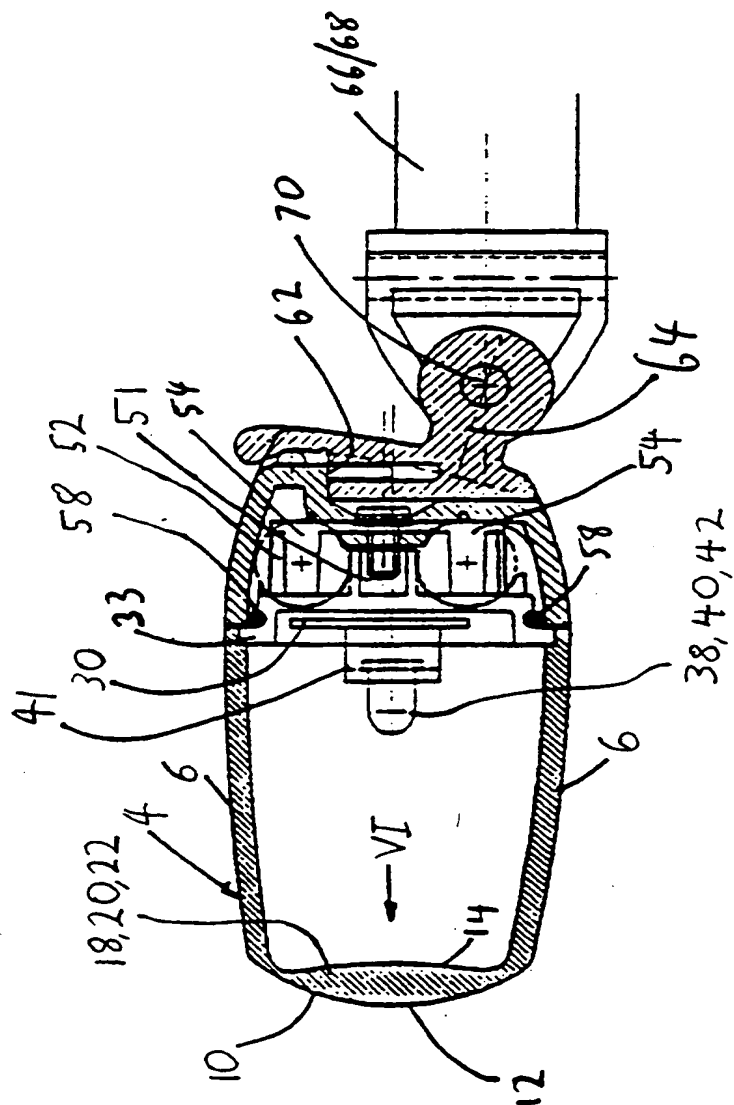
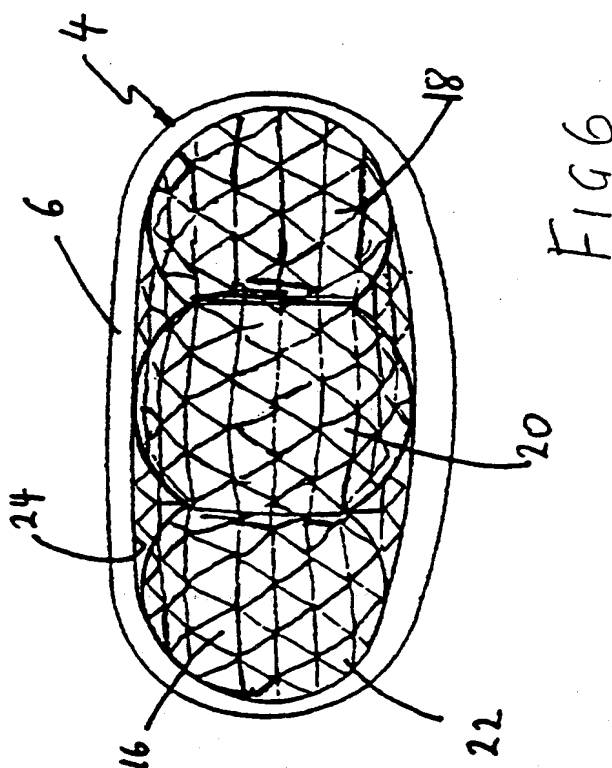


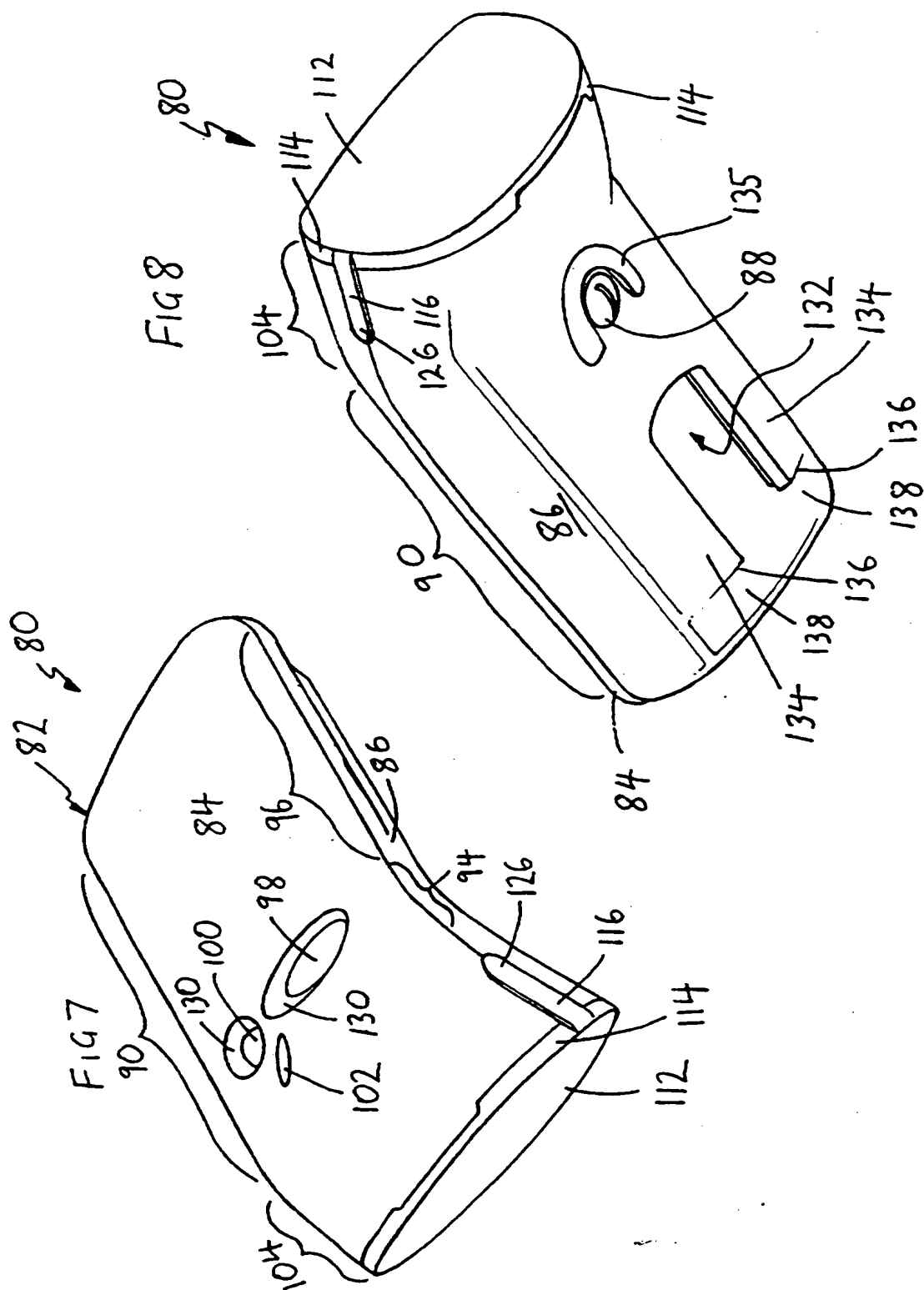
FIG 3



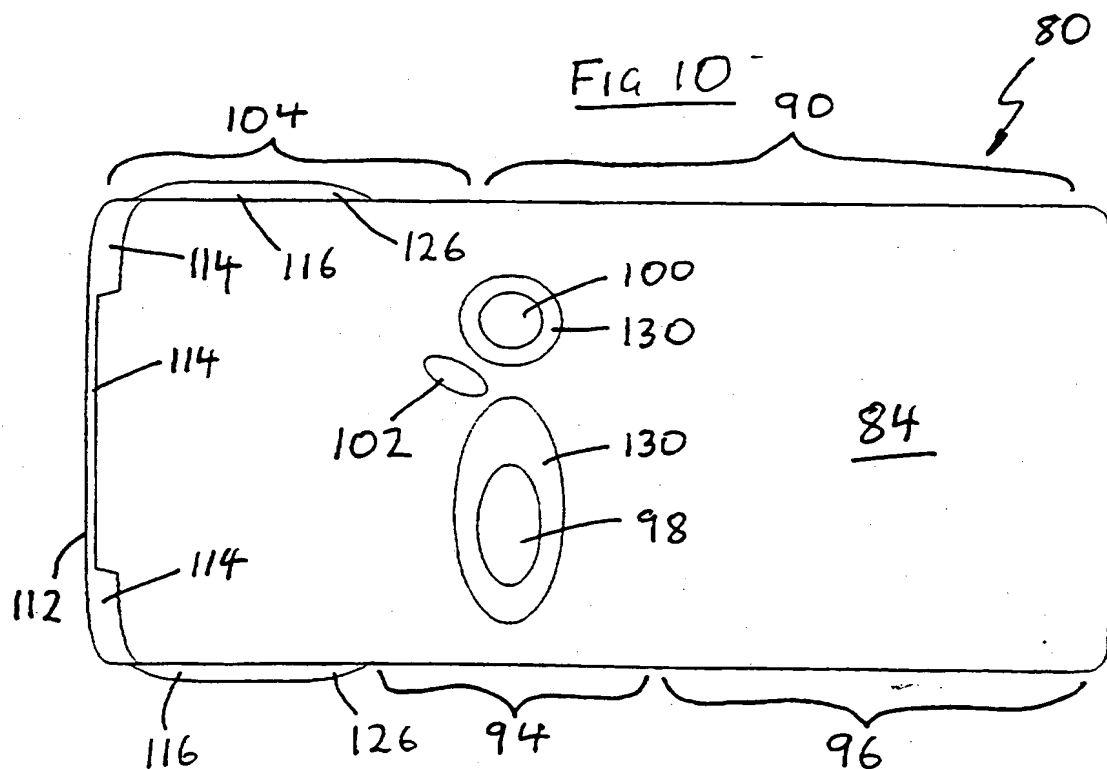
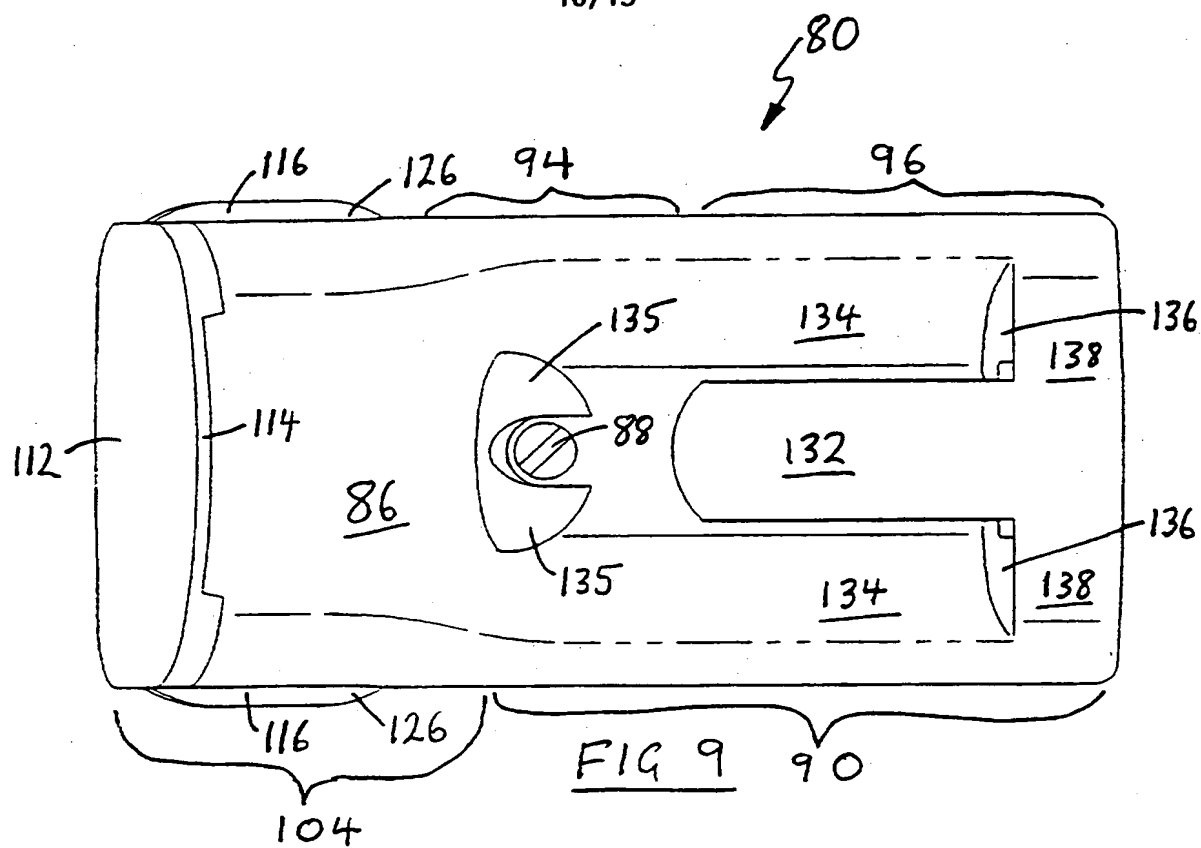


50



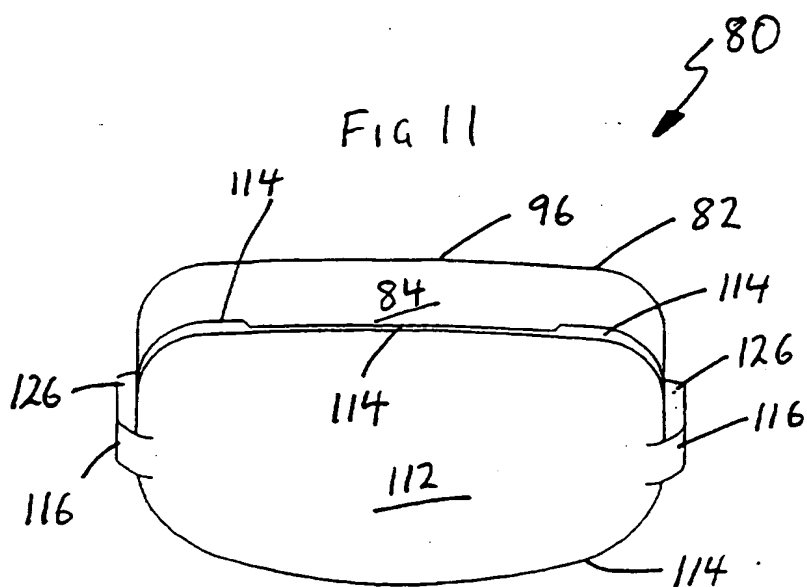
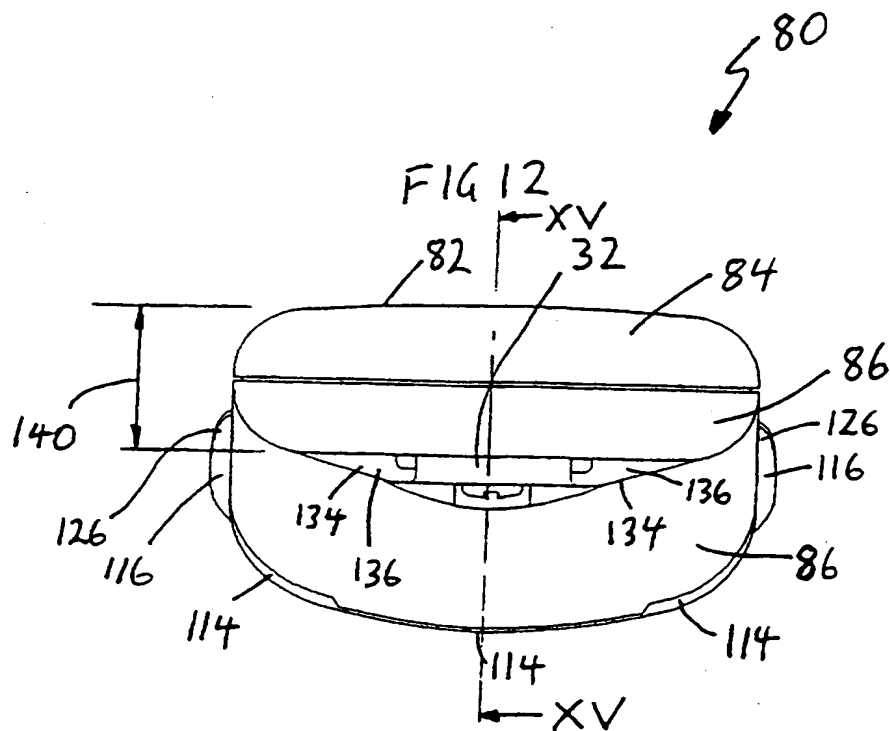


10/15

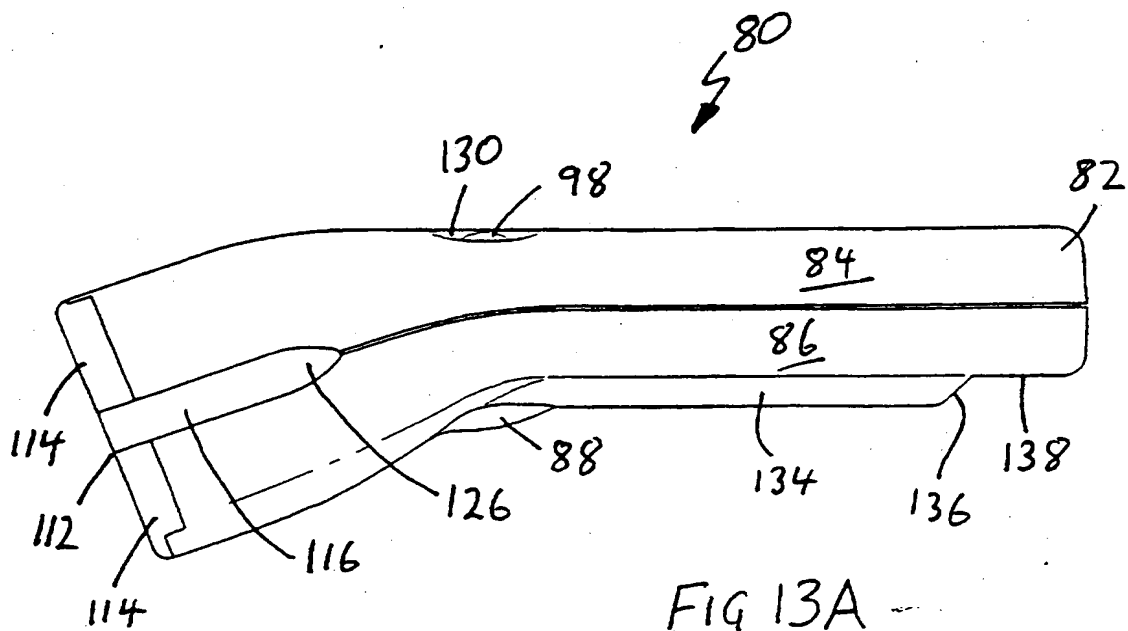
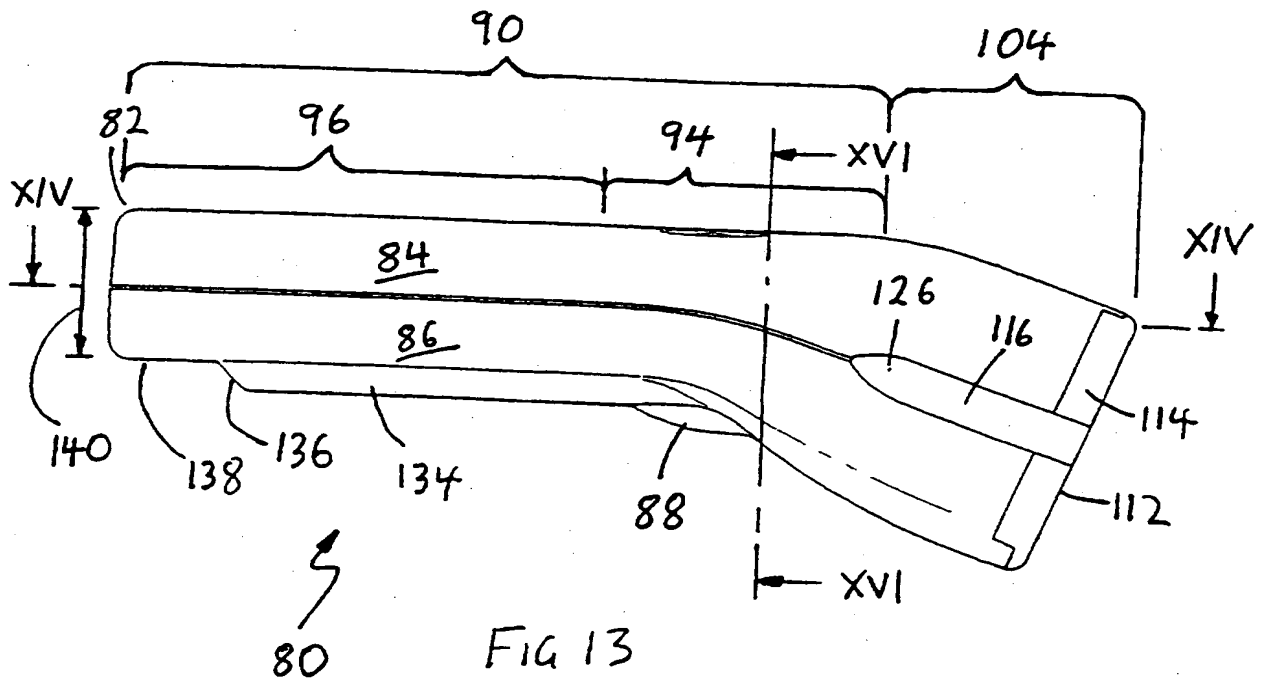


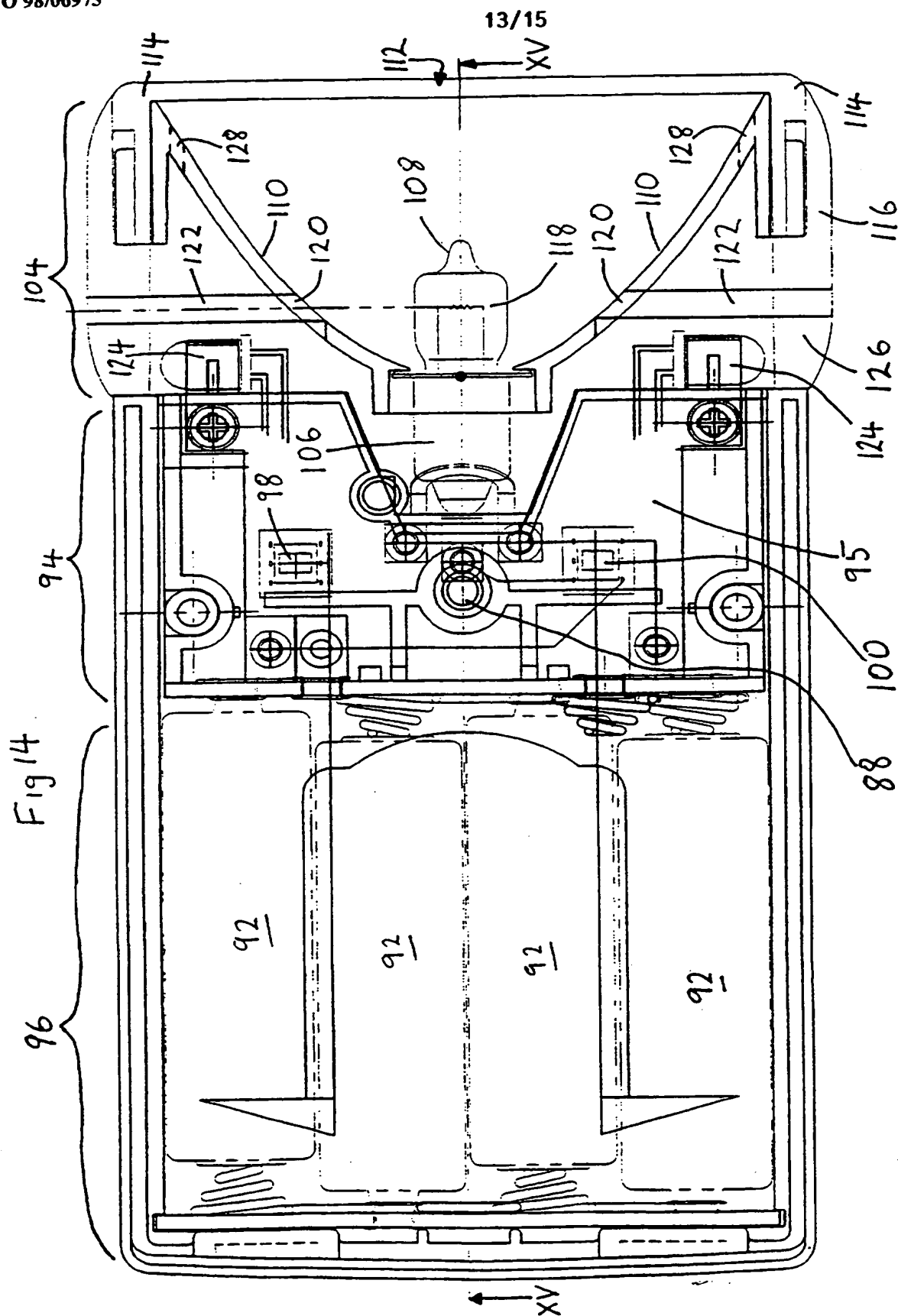


11/15



12/15





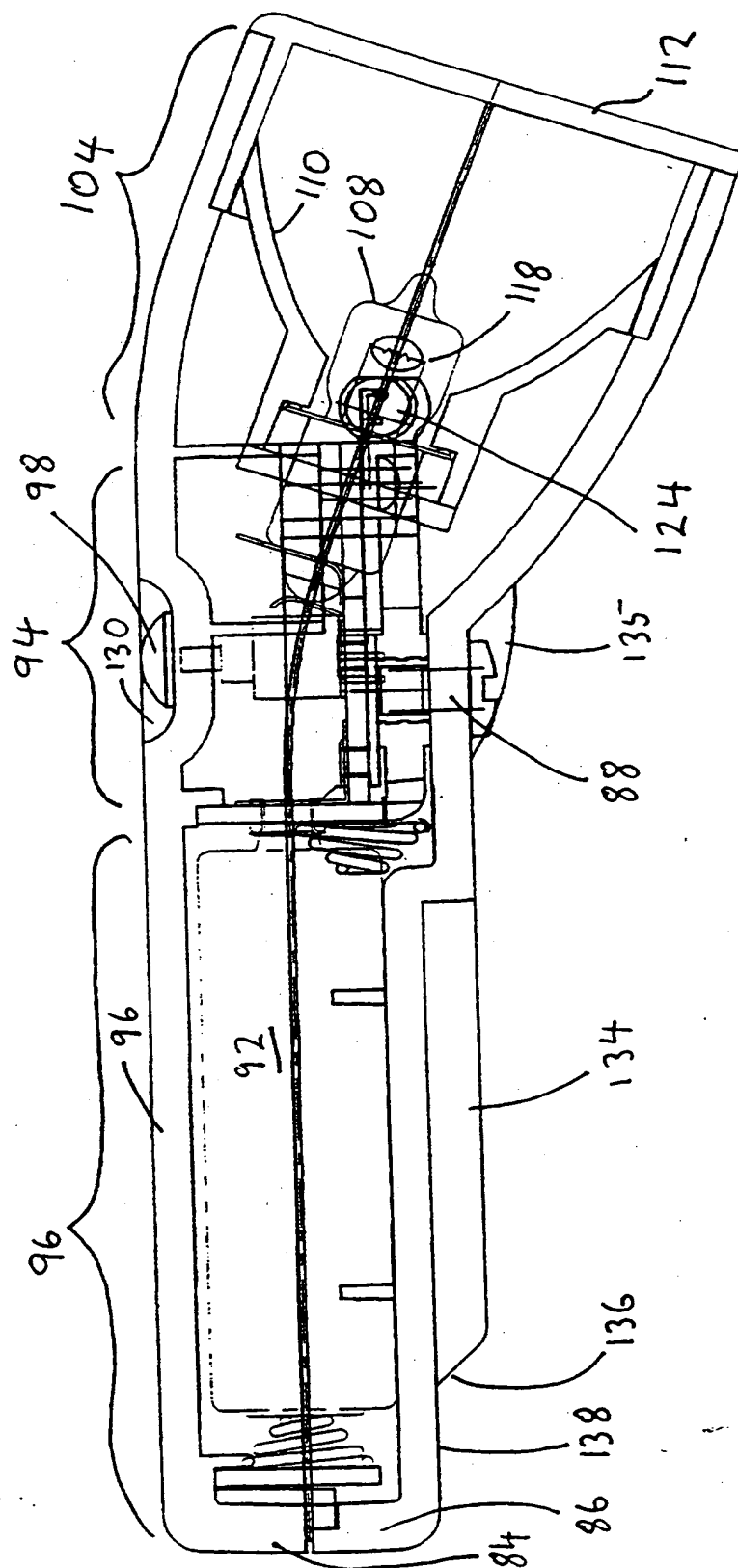
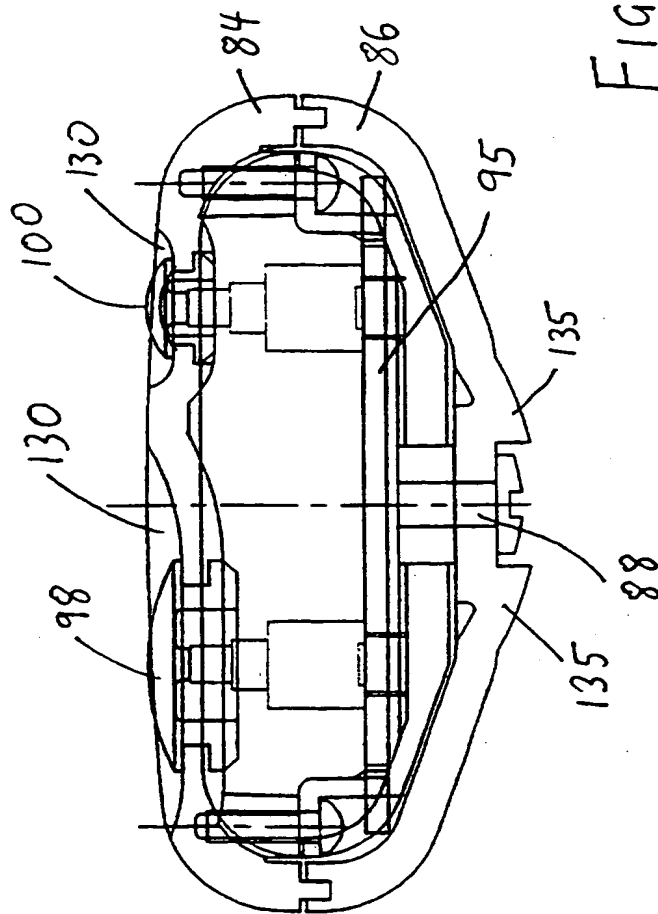


Fig 15



# INTERNATIONAL SEARCH REPORT

International Application No.  
PCT/AU 97/00513

## A. CLASSIFICATION OF SUBJECT MATTER

Int Cl<sup>B</sup> F21L 15/02, 7/00, 15/06, B62J 6/04, 6/02, 6/20

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
IPC: F21L, B62J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
AU: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
WPAT: IPC as above with keywords light:, lamp#, LED#, diode#, side:, facet:, mount:, fair:, reflector:, bicycle#, lens:

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Derwent Abstract Accession No 96-282649/29, Class Q16, Q71, JP 8-119035 A (KOBAYASHI) 14 May 1996 Figure; abstract	1-3
X	Derwent Abstract Accession No. 94-296453/37, Class Q71, GB 2276713 A (SINCLAIR) 5 October 1993 Figure; abstract	1-3, 25
X	US 5384693 A (SCHWALLER et al.) 24 January 1995 Figures 1-7; column 1, lines 32-35; column 2, line 8 - column 3, line 41	1-3, 46-47

☒ Further documents are listed in the continuation of Box C

☒ See patent family annex

<ul style="list-style-type: none"> <li>* Special categories of cited documents:</li> <li>"A" document defining the general state of the art which is not considered to be of particular relevance</li> <li>"E" earlier document but published on or after the international filing date</li> <li>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</li> <li>"O" document referring to an oral disclosure, use, exhibition or other means</li> <li>"P" document published prior to the international filing date but later than the priority date claimed</li> </ul>	<ul style="list-style-type: none"> <li>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</li> <li>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</li> <li>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</li> <li>"&amp;" document member of the same patent family</li> </ul>
---	--

Date of the actual completion of the international search  
29 October 1997

Date of mailing of the international search report  
**05 NOV 1997**

Name and mailing address of the ISA/AU  
AUSTRALIAN INDUSTRIAL PROPERTY ORGANISATION  
PO BOX 200  
WODEN ACT 2606  
AUSTRALIA Facsimile No.: (02) 6285 3929

Authorized officer  
**RAJEEV DESHMUKH**  
Telephone No.: (02) 6283 2145

C (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5006971 A (JENKINS) 9 April 1991 Figures 1-3; column 1, line 42 - column 2, line 55	1-7
P,X	EP 762049 A (VALEO VISION) 12 March 1997 Figures 1, 2, 6; column 2, line 27 - column 4, line 11	20, 25, 46
X	GB 2297149 A (DORMAN TRAFFIC PRODUCTS LIMITED) 24 July 1996 Figures 1-4; page 9, line 15 - page 13, line 25	20-24
X	US 5174649 A (ALSTON) 29 December 1992 Figures 1A, 1B; column 1, lines 56-68; column 6, lines 25-63	20-24
X	Derwent Abstract Accession No. 96-274505/28, Class Q71, JP 8-115602 A (HIDAKA SANGYO KK) 7 May 1996 Figure; abstract	25
X	Derwent Abstract Accession No. 96-069211/08, Classes Q41, Q71, CA 2147133 A (HERRINGTON) 16 October 1995 Figure; abstract	25
X	DE 4224061 A (BUSCH & MÜLLER FAHRZEUGTEILE-FABRIK) 27 January 1994 Figures; column 3, line 41 - column 4, line 48	25, 46
A	FR 2658150 A (FAVIER) 16 August 1991 Figure 1; page 3, lines 16-25	25
X	GB 2184824 A (DURACELL INTERNATIONAL INC.) 1 July 1987 Figures 1, 2, 4, 6-8; page 1, line 86 - page 2, line 87	20, 25, 46
X	GB 2166860 A (VEE-CON PLASTICS LIMITED) 14 May 1986 Figure 1; abstract	25
X	Derwent Abstract Accession No. 96-305700/31, Classes X22, X26, JP 8-133151 A (SANYO ELECTRIC CO LTD) 28 May 1996 Figure; abstract	32-33
X	US 4845599 A (LIEVIN) 4 July 1989 Figures 1-3; column 1, lines 51-68	32-33
X	DE 3604264 A (FIEDLER) 27 August 1987 Figure 1; abstract	32-33
X	DE 2953938 A (DEPAT LTD.) 23 September 1982 Figures 1-2; abstract	32-33
X	DE 4337456 A (S & M SICHERHEITSLYTEINRICHTUNGEN UND MONTAGE GMBH & CO. KG) 4 May 1995 Figures 1, 2; abstract	44-45

continued

**AUSTRALIAN PATENT OFFICE  
SEARCH REPORT**

Application No.  
AU 97/00513

C (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4577261 A (TSUYAMA) 18 March 1986 Figure 5: column 2, line 65 - column 3, line 10	44-45
A	Derwent Abstract Accession No 84-231314/38, Class Q23, BE 899575 A (KOCKAERT) 31 August 1984 Abstract	44-45



# INTERNATIONAL SEARCH REPORT

International Application No.

PCT/AU 97/00513

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

- 1 ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
- 2 ☐ Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
- 3 ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See attached sheet.

- 1 ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims
- 2 ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
- 3 ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
- 4 ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.  
☐ No protest accompanied the payment of additional search fees.

## Box II continued

According to PCT Rule 13.1, the international application shall relate to one invention only or to a group of inventions so linked as to form a single general inventive concept ("requirement of unity of invention"). The circumstances in which the requirement of invention is to be considered fulfilled are specified in PCT Rule 13.2. Where a group of inventions is claimed in one and the same international application, the requirement of the unity of invention referred to in Rule 13.1 shall be fulfilled only when there is a technical relationship among those inventions involving one or more of the same or corresponding special technical features. The expression "special technical features" shall mean those technical features that define a contribution which each of the claimed inventions, considered as a whole, makes over the prior art.

The present international application has six groups of claimed inventions, each having one independent claim and other dependent claims. Each claim is a product claim. It is considered by this International Searching Authority that each group of claimed inventions is characterised by its own special technical features (as described below). The special technical features of any one of these groups are not present in the remaining groups. Consequently there is no technical relationship among these inventions "involving one or more of the same or corresponding special technical features". Therefore the present international application does not comply with PCT Rule 13.1. (See further explanation on the next sheet.)

Claims 1-19: A lighting device with lens sections being arranged so that light emitted from the diodes passing through lens sections travels in at least two directions away from the lighting device.

The special technical features of this group are the use of multiple diodes, and multiple lenses, each lens being associated with a corresponding diode, the arrangement being such that the light from each diode travels in a different direction.

Claims 20-24: A lighting device having a multifaceted lens portion so that there are seen multiple sources of light or multiple images of at least one light emitting diode.

The special technical features of this group are the use of a single multi-faceted lens associated with a single light source, so that a greater number of images of the same light source are seen from the other side.

Claims 25-31: A lighting device having a frosted or translucent wall surface to give the wall section a glowing or illuminating appearance.

The special technical features of this group are the provision of a glowing wall portion, in addition to any lens provided on the lighting device.

Claims 32-43: A lighting device having a reflector with at least two openings or channelling means.

The special technical features of this group are the use of a reflector having openings or channelling means.

Claims 44-45: A bicycle light having a mounting bracket portion having faired surfaces tapering from the side peripheries.

The special technical features of this group are the provision of a faired mounting bracket permitting a more comfortable grip.

Claims 46-55: A lighting device having a lens section, the lens section having at least two side portions through which light is visible.

The special technical features of this group are the at least two side portions of the lens section of a lighting device.

continued

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International Application No.  
PCT/ AU 97/00513

## Box II continued

Prima facie there are six different inventions. However, claims 1-19, 25-31, 32-43 and 46-55 have a common concept that the light is emitted in at least two different directions, making the lighting device visible from at least two different directions. It cannot be said *a priori* that these four groups claim different inventions. However the invention of claims 20-24 clearly does not have the feature of different directions.

Similarly claims 44-45 clearly deal with a different invention about a faired mounting bracket.

The International Searching Authority found that *a priori* the present application includes at least three different inventions. The International Searching Authority therefore invited the applicant to pay additional fees for two additional inventions. These fees were timely paid by the applicant.

### Information on patent family members

**PCT/AU 97/00513**

particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report				Patent Family Member			
US	5384693	AT EP	130261 567774	CH JP	682142 6-24371	DE	59300929
EP	762049	FR	2738621	JP	9-180517		
US	5174649	AT EP MX	136631 523927 9204167	CA FI NO	2073751 923144 922822	DE JP	69209736 5-190907
GB	2184824	US	4803608				
US	4845599	AT	70235	CA	1312586	DE	3775197
		DK	6457/87	EP	274675	FI	875385
		FR	2608254	JP	63-190201	NO	875080
US	4577261	CA GB	1247575 2145810	FR	2551416	DE	3428256
END OF ANNEX							